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STACKS-S.B.T

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EFFECT OF THE 55 MPH SPEED LIMIT LAW ON FATAL CRASHES IN TEXAS

By

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Summary

In October 1973, the Middle East oil embargo produced a fuel crisis in the United States and led to the imposition of a nationwide 55 mph maximum speed limit law. This study examines the effect of the 55 mph maximum speed limit law on fatal accidents in the State of Texas. By use of time series analysis known as "intervention analysis"^{1, 2}, it is concluded that the 55 mph speed limit resulted in a reduction of 19.8 fatal accidents per month.

Section I—Background

In October 1973, the Middle East oil embargo began and by November, the retail fuel supply had deteriorated to the point where "waiting lines" were a common occurrence in many areas.³ On January 2, 1974, Congress passed into law the "Emergency Highway Energy Conservation Act" as one attempt to cut fuel consumption. This legislation, together with other factors growing out of the fuel crisis, produced two significant changes in driving patterns in the United States. There was a reduction in total vehicle miles traveled and in the average speed on the nation's highways.

According to recently published NHTSA Technical Reports^{3, 4}, the reduction in travel began in July 1973 and continued until November of 1974. The average reduction in miles traveled in 1974 was 2.6 percent. The reduction was greater on main rural roads than on urban and local rural roads, and was most severe during the period January through March 1974 with a peak in February of 8.5 percent.

In the United States main rural roads (which include the Interstate Rural System) account for almost all high speed driving and carry about one-third of all travel. It was on these roads that the greatest changes in speed and amount of travel occurred during the fuel crisis period.

The average speed on all main rural roads dropped 5 mph in 1974 (60.3 to 55.3) or 8.3 percent. Table 1 summarizes average speed reduction by road type.

Table 1

Road Type	Reduction	Actual Speed Change
<u>Main Rural Roads</u>		
Rural Interstate	7.4 mph	65.0-57.6
Rural Primary	3.6 mph	57.1-53.5
<u>Other</u>		
Rural Secondary	3.9 mph	57.0-53.1
Urban Primary	(Only Minor Changes)	

¹ G. E. P. Box and G. M. Jenkins, *Time Series Analysis Forecasting and Control*, Holden Day, 1970.

² G. E. P. Box and G. C. Tiao, "Intervention Analysis with Applications to Economic and Environmental Problems," *Journal of the American Statistical Association*, March 1975, Volume 70, Number 349.

³ E. C. Cerrelli, "The Effect of the Fuel Shortage on Travel and Highway Safety," DOT HS-801 715, August 1975.

⁴ C. J. Kahane, "Lower Speed Limits, Reduced Speeds, Fewer Deaths, January-April 1974," DOT HS-801 667, August 1975.

During the entire year of 1974, total travel on main rural roads dropped 16 billion vehicle miles (a reduction of 3.3 percent from 469 to 453) and the average speed reduction of 5 mph was accompanied by a 28 percent reduction in speed variability (the standard deviation dropped from 9.5 to 6.8 mph). The shift in amount of travel at high speeds on main rural roads can be seen in Table 2.

Table 2

Speed Range	Change
Less than 45 mph	+10 percent
45-62 mph	+50 percent
Greater than 62 mph	-70 percent

Highway casualties generally demonstrated reductions proportionate to the changes in travel and speed. During January through April 1974, fatal crashes decreased from 1973 levels more sharply on high speed roads (29 percent) than on low speed roads (15 percent). High speed roads are designated as those roads which in 1973 had a speed limit above 55 mph and were reduced to 55 mph by March 1974. In addition, the greatest percentage drop in injuries was experienced at the higher severity injury levels, characteristic of higher speed crashes.

Section II—Impact of 55 mph Speed Limit in Texas

In order to evaluate the effect of the 55 mph maximum speed limit law, fatal accidents were divided into two time series of data. One series represents

fatal accidents on roads whose posted speed limit exceeded 55 mph prior to imposition of the law, and the other series represents fatal accidents on roads not affected by the 55 mph speed limit law. Data on fatal accidents were collected monthly from 1971 through 1975, thus generating 60 data points upon which to measure differential impact. The 55 mph fatal accident series used in the analysis represents the sum of the fatal accidents occurring on Interstate U.S. and State highways in Texas. The difference between these monthly fatal accidents and total monthly fatal accidents was used as a comparison series to represent fatal accidents occurring on roads not affected by the imposition of the 55 mph speed limit law. The data source used was "Motor Vehicle Traffic Accidents" prepared by the Texas Department of Public Safety for calendar years 1971 through 1975. The data for the two series appear in Table 3.

The graph of monthly fatal accidents occurring on highways affected by the 55 mph speed limit law (col. 1—Table 3) appears in Figure 1. For the years 1971 through 1973, three definite patterns can be seen: (1) a very strong annual seasonal pattern exists for each of the three years; (2) there does not appear to be any change in level in the average monthly fatal accidents from year to year; and (3) a dramatic reduction in fatal crashes occurred during the end of 1973 and the beginning of 1974, at a time when the nation was experiencing the effect of an energy crisis (October 1973 through March 1974) and the imposition of the 55 mph speed limit law.

Table 3
Monthly Fatal Accidents in Texas

	1971		1972		1973		1974		1975	
	(1) Int/ U.S.	(2) Other	(1) Int/ U.S.	(2) Other	(1) Int/ U.S.	(2) Other	(1) Int/ U.S.	(2) Other	(1) Int/ U.S.	(2) Other
January	80	160	87	154	71	130	59	135	63	158
February	66	121	70	143	86	139	45	98	60	146
March	90	142	78	173	97	167	73	142	72	164
April	81	160	96	175	93	161	61	125	61	184
May	83	166	33	149	88	154	64	141	92	154
June	97	160	39	156	102	175	69	163	85	189
July	110	174	117	192	86	173	89	176	84	175
August	88	157	103	154	111	189	85	188	68	168
September	84	161	35	166	100	185	63	152	83	174
October	93	196	75	164	97	186	72	180	75	182
November	97	161	103	170	64	176	62	159	67	177
December	91	175	115	182	87	157	59	166	78	186

Fatal Accidents on 55 MPH Roadway in Texas

Graph of Series

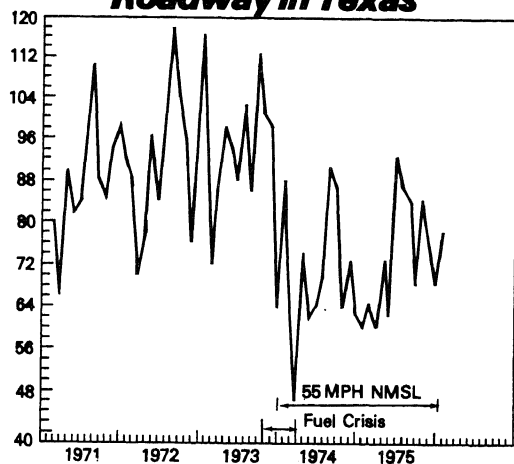


Figure 1

In March 1974, at the end of the fuel crisis, one would have expected the level of fatal accidents to have returned to that of the pre-energy crisis, i.e., an average of approximately 88 crashes per month. However, the fatal accident series on the 55 mph roads returned to a level of only 68 fatal crashes per month. This phenomenon occurred only after the imposition of the 55 mph speed limit law.

Figure 2 represents monthly fatal accidents on roads not affected by the 55 mph speed limit law for calendar years 1971 through 1975. Again, a strong annual seasonal pattern is observed for 1971 through

Fatal Accidents on Non-55 MPH Roadway in Texas

Graph of Series

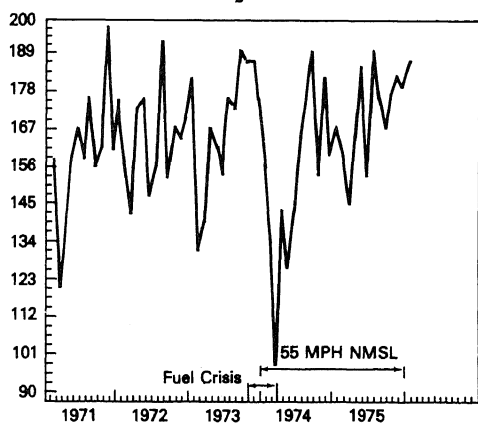


Figure 2

1973 accompanied by a dramatic reduction in fatal accidents during the energy crisis (October 1973 through March 1974). However, the fatal accident series in this case returns to a pre-energy crisis level of approximately 165 fatal accidents per month.

Graphs of these two series appear in Figures 3 and 4 respectively. The patterns in each graph are very similar and consistent with each other; namely, a strong annual seasonal pattern exists for calendar years 1971 through 1973, a reduction in miles traveled during the energy crisis and a return to the same upward pre-energy period trend after the end of the fuel crisis in March 1974. The energy crisis merely in-

Monthly Vehicle Miles (Millions) on Urban Roads in Texas

Graph of Series

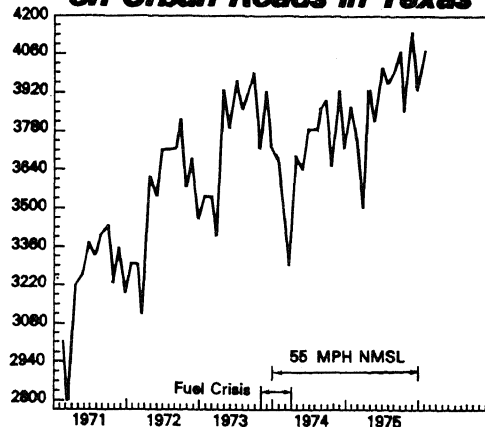


Figure 3

Monthly Vehicle Miles (Millions) on Main Rural Roads in Texas

Graph of Series

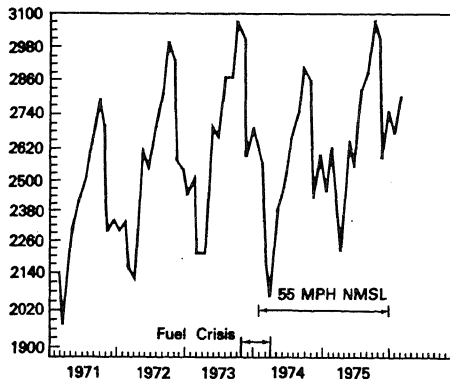


Figure 4

interrupts and displaces the upward trends in vehicle mile growth, although the rate of growth on urban roads appears higher than on main rural roads.

It is conceivable that the differential effect in fatal accidents occurring in the post energy crisis period can be attributed to the 55 mph speed limit law. However, one must examine the pattern of vehicle miles traveled in each of the two data series for consistent trend movements in order to conclude that the differential effect was due to the 55 mph speed limit law.

Table 4 represents monthly vehicle miles traveled (millions) for calendar years 1971 through 1975 on urban and main rural roads in Texas. If the 55 mph speed limit law caused a reduction in vehicle miles traveled, then for the period beginning January 1974, one would expect to see a change in level in vehicle miles traveled only on main rural roads. Data for the vehicle miles traveled were compiled from Traffic Volume Trends Report prepared by Federal Highway Administration, Program Management Division.

Since the trend characteristics of mileage traveled are almost identical for each type of road in terms of trend direction, annual seasonal patterns, and effect due to energy, vehicle miles traveled did not have an effect on the lower level of fatal accidents occurring on roads impacted by the 55 mph speed limit law. It is, therefore, reasonable to conclude that the 55 mph speed limit law had significant "bottom line" impact in reducing fatal accidents during the 1974-1975 time frame in Texas.

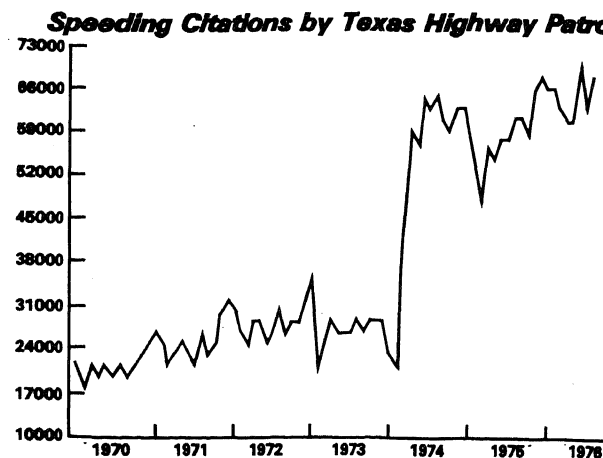


Figure 5

Section III—Statistical Evaluation of 55 mph Speed Limit Impact in Texas

The analysis of the 55 mph speed limit in Section II results from a comprehensive statistical analysis utilizing Box-Jenkins Time Series Analysis techniques. In particular, an adaptation of this technique known as "intervention analysis"¹ was used to measure the impact of the 55 mph along with known confounding factors such as the energy crisis and ve

¹ G. E. P. Box and G. C. Tiao, "Intervention Analysis with Applications to Economic and Environmental Problems," *Journal of the American Statistical Association*, March 1975, Volume 70, Number 349.

Table 4

Monthly Vehicle Miles Traveled in Texas (In Millions of Miles)

	1971		1972		1973		1974		1975	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
January	2996	2132	3295	2184	3520	2239	3490	2192	3752	2431
February	2815	1986	3114	2131	3402	2235	3299	2091	3511	2241
March	3219	2314	3589	2628	3912	2708	3660	2423	3919	2691
April	3257	2451	3533	2555	3781	2670	3634	2516	3827	2581
May	3374	2522	3710	2699	3968	2892	3787	2678	3992	2851
June	3336	2637	3712	2842	3835	2897	3786	2771	3955	2921
July	3403	2806	3722	3023	3907	3080	3841	2924	4007	3081
August	3421	2705	3805	2964	3989	3029	3891	2877	4067	3041
September	3235	2325	3571	2580	2718	2630	3649	2459	3858	2631
October	3353	2363	3673	2571	3915	2697	3912	2620	4115	2751
November	3198	2329	3449	2460	3704	2592	3705	2500	3918	2701
December	3297	2351	3528	2518	3682	2592	3865	2657	4049	2821

hicle miles traveled interacting with the impact variables. Intervention analysis is used to measure the impact of the presence or absence of a policy, a condition or the imposition of a law to address the question that "given that an intervention has occurred (i.e., passage of a 55 mph speed limit law) did it have an impact on the reduction of accidents on roads where potential reduction in fatal accidents could be realized." Although a national law was passed, it must also be shown that some intervention took place in Texas in order to link the results to the intervention.

In this application of "intervention analysis," three input and one output series are used. The input series are used to represent the effect of the energy crisis, the 55 mph speed limit law, and vehicle miles traveled on fatal accidents for two sets of roads. The input series for energy and 55 mph are coded "zero" or "one" to signify the absence or presence of the condition it represents for each month in the study.

Therefore the input series representing the fuel crisis is "zero" for each month of the five years except for its value of "one" from October 1973 through March 1974, representing the presence of the fuel crisis. The 55 mph speed limit series is coded "zero" for each month through 1973 and assumes the value "one" beginning January 1974 and remains at this level throughout the analysis. The vehicle miles traveled series consists of the two sets of data in Table 4. The two output series are the monthly fatal accidents occurring on roads impacted by the 55 mph speed limit law and not affected by the 55 mph speed limit law.

"Intervention analysis" is a generalized regression analysis of time series variables. Each of the input or independent variables is a time series in itself, while the output variable is also a time series. Classical regression analysis is not applicable when the data (either or both of the input and output series) are time dependent or correlated. The Box-Jenkins generalized regression approach, however, can determine the dependence of each data point in a series with its own history and then determine the relationship between the independent variable time series and the dependent variable time series. This relationship between the input series and the output series is found in the development of the transfer function (i.e., how much change in the activity of the output variable can be explained by the movement of the input variables). If a transfer function can be developed, it provides, in an explicit, dynamic way, all of the interrelationships that exist between the variables. It can then be used as a forecasting and feedback mechanism to control the movements of the output variable as it relates to the input variables.

Tables 5 and 6 represent the Highway Patrol speeding citations and warnings from January 1970 through June 1976.* It is interesting to note that a dramatic change in level of speeding citations and warnings took place coincident with the imposition of the 55 mph speed limit law in Texas. This is evident in the graphs of Figures 5 and 6 showing the significant change in citation and warning levels, thereby establishing an intervention as a result of the law.

* Data after October 1974 contain citations and warnings due to violations of 55 mph only.

Table 5
Texas Highway Patrol Speeding Arrests

Month	1970	1971	1972	1973	1974	1975	1976
January	20,059	23,664	25,382	20,548	21,104	54,223	65,126
February	17,615	19,648	24,630	24,630	42,941	47,036	62,600
March	20,022	22,762	28,248	28,111	58,869	56,197	60,424
April	18,617	23,912	26,768	24,919	57,539	53,261	61,109
May	19,682	22,329	24,663	26,387	63,496	56,646	70,072
June	18,654	20,810	25,598	25,458	63,179	56,432	62,628
July	20,179	24,981	29,688	26,933	64,509	61,592	67,444
August	18,377	22,076	25,172	25,904	61,258	60,458	
September	20,587	23,610	27,391	27,807	58,382	58,643	
October	22,394	28,998	28,152	27,103	62,158	65,288	
November	24,720	30,477	30,641	26,877	63,315	67,108	
December	26,381	29,224	34,454	21,991	59,682	65,925	
Total	247,287	292,491	330,745	306,668	676,432	702,809	449,403

Table 6

Texas Highway Patrol Speed Warnings

Month	1970	1971	1972	1973	1974	1975	1976
January	4,756	5,604	6,389	5,178	6,091	13,273	15,417
February	4,233	4,838	6,183	6,437	9,604	10,763	15,023
March	4,696	5,538	7,047	7,326	11,677	13,110	14,777
April	4,548	5,874	6,774	6,700	11,685	13,448	14,447
May	5,223	6,280	7,319	7,615	13,034	12,787	16,796
June	5,415	5,863	8,103	7,825	13,934	13,180	16,140
July	5,418	7,181	9,191	8,316	14,462	14,628	18,326
August	4,614	6,094	8,123	7,762	13,269	14,750	
September	4,780	6,418	7,373	7,420	12,524	13,507	
October	4,970	7,733	7,136	7,483	13,323	14,987	
November	5,033	7,481	6,758	7,268	13,142	14,521	
December	5,700	7,319	7,976	6,051	14,343	15,827	
Total	59,386	76,223	88,372	85,381	147,088	163,781	110,926

A transfer function model was developed relating the impact of the presence of the fuel crisis, 55 mph speed limit law, and vehicle miles traveled to fatal accidents occurring on 55 mph roads in Texas. The results and parameters of the model appear in Table 7 and may be interpreted as follows.

The impact of the fuel crisis, while it was in effect, resulted in a reduction of 14.8 fatal crashes per month. This is a statistically significant result since a reduction of this magnitude could only have occurred by chance in one in a thousand. The impact of the 55 mph speed limit law resulted in a reduction of 19.8

Table 7

Transfer Function Model for Accidents on 55 MPH NMSL Roads Using Fuel, Speed, Main Rural Mileage Traveled

	Fuel Crisis	55 MPH NMSL	Main Rural Mileage
Parameter Estimate	-14.8	-19.8	CCF=0
Standard Deviation	5.5	3.4	
Computed t Value	-2.73	-5.79	
Delay Time	1 mos.	0 mos.	

$$Y_t = -14.8 X_{t-1}^{FC} - 19.8 X_t^{SL} + (1 + .12B) a_t$$

Y_t = fatal accidents on 55 mph roads during time period t

X^{FC} = fuel crisis dummy variable (0,1)

X^{SL} = 55 mph speed limit dummy variable (0,1)

a_t = random component at time period t

B = backshift operator such that $Ba_t = a_{t-1}$

$t-1$ = time period prior to t

Speeding Warnings by Texas Highway Patrol

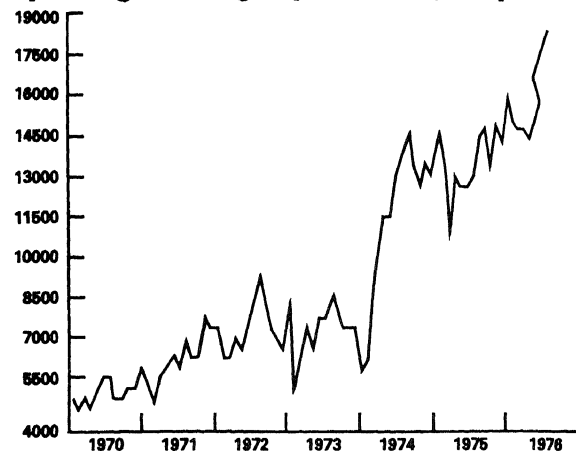


Figure 6

fatal accidents per month with a probability due to chance of less than one in a thousand. Urban mileage has no effect since the cross correlation function is zero. The relationship between fatal accidents and the input variables is expressed by the formula for Y_t .

Table 8 represents the transfer function model parameters between fatal accidents on non-55 mph roads the fuel crisis, 55 mph speed limit, and urban mileage traveled. The only significant parameter is the effect due to fuel crisis with an estimated reduction of 11.6 fatal accidents per month while in effect. The 55 mph speed limit law showed no significant impact on fatal accidents since no reductions in speed resulted on these roads.

Tables 9 and 10 contain transfer function model parameter estimates and analysis of the effect of fuel crisis and the 55 mph speed limit law on vehicle miles traveled on urban and main rural roads.

For both main rural miles traveled (55 mph roads) and urban miles traveled (non-55 mph roads), the fuel crisis resulted in a significant reduction of vehicle miles traveled. However, the presence of the 55 mph speed limit law showed no significant effect on vehicle miles traveled.

Table 8

Transfer Function Model for Accidents on Non-55 MPH NMSL Roads—Using Fuel, Speed, Urban Mileage Traveled

	Fuel Crisis	55 MPH NMSL	Urban Mileage
Parameter Estimate	-11.6	6.4	.02
Standard Deviation	5.2	6.4	.02
Computed t Value	- 2.24	1.01	1.00
Delay Time	5 Mos.	4 Mos.	1 Mos.

$$(1-B^{12})Y_t = -11.6 X_{t-5}^{FC} + 6.4 X_{t-3}^{SL} + .02 X_{t-1}^{UM} +$$

$$(1+.22B+.89B^2) (1-.59B^{12}) a_t$$

Y_t = fatal accidents on non-55 mph roads during time period t

X^{FC} = fuel crisis dummy variable (0,1)

X^{SL} = 55 mph speed limit dummy variable (0,1)

a_t = random component at time period t

B = back shift operator such that $Ba_t = a_{t-1}$

t = time period prior to t

Table 9

Transfer Function Model for Main Rural Mileage Using Fuel Crisis and Speed Limit Dummy Variables

	Fuel Crisis	55 MPH NMSL
Parameter Estimate	-63.0	CCF=0
Standard Deviation	25.3	
Computed t Value	- 2.25	
Delay Time	0 mos.	

$$(1-B) (1-B^{12}) Y_t = -63.0 X_t^{FC} + (1-.42B) (1-.008B^{12}) a_t$$

Table 10

Transfer Function Model for Urban Mileage As a Function of Fuel Crisis and Speed Limit Dummy Variables

	Fuel Crisis	55 MPH NMSL
Parameter Estimate	-71.6	CCF=0
Standard Deviation	30.0	
Computed t Value	- 2.39	
Delay Time	1 mos.	

$$(1-B) (1-B^{12}) Y_t = -71.6 X_{t-1}^{FC} + (1-.07B^{12}) a_t$$

Summary

The imposition of the 55 mph speed limit law in Texas resulted in a dramatic reduction of fatal accidents on those roads where the speed limits were reduced to 55 mph. The steady state gain was -19.8 fatal accidents per month. On roads other than the 55 mph roads, no impact was noted. The fuel crisis, however, resulted in significant reductions on both sets of roads while in effect. Although vehicle mileage traveled was affected by the fuel crisis, it was not affected by the 55 mph speed limit law. Nor did vehicle mileage traveled have any impact on the reduction of fatal accidents in either series.

Bibliography

1. G. E. P. Box and G. M. Jenkins, *Time Series Analysis Forecasting and Control*, Holden Day, 1970.
2. G. E. P. Box and G. C. Tiao, "Intervention Analysis with Applications to Economic and Environmental Problems," *Journal of the American Statistical Association*, March 1975, Volume 70, Number 349.
3. E. C. Cerrelli, "The Effect of the Fuel Shortage on Travel and Highway Safety," DOT HS-801 715, August 1975.
4. C. J. Kahane, "Lower Speed Limits, Reduced Speeds, Fewer Deaths, January-April 1974," DOT HS-801 667, August 1975.
5. Mileage Data from Federal Highway Administration, *Traffic Volume Trends*, Table 5A.
6. Texas Fatal Accident Data from Texas Dept. of Public Safety, "Motor Vehicle Traffic Accidents."

ABSTRACT CITATIONS

HS-018 959

EFFECTS OF SINGLE EXPOSURES OF CARBON MONOXIDE ON SENSORY AND PSYCHOMOTOR RESPONSE

Twenty young, healthy male subjects exposed to a single exposure of 650 ppm carbon monoxide (CO) for 45 minutes increased their mean carboxyhemoglobin (COHb) by 7.61%. Another twenty subjects exposed to 950 ppm CO for 45 minutes increased their COHb by 11.22%. Before and after exposures all subjects were given tests for depth perception, visual discrimination for brightness, reaction time to a visual stimulus, and flicker fusion discrimination. The only test showing significant mean decrement after exposure was the reaction time test, and the decrement produced by each group was essentially the same.

by James M. Ramsey
Publ: American Industrial Hygiene Association Journal v34
p212-6 (May 1973)
1973; 14refs
Availability: See publication

HS-018 960

AUTOMOTIVE ENERGY EFFICIENCY PROGRAM. PAPERS PRESENTED AT THE AUTOMOBILE ENGINE CONTROL SYMPOSIUM JULY 8 AND 9, 1975

Objective of the symposium was to provide a forum for technical interchange between investigators with regard to potential benefits in fuel economy and emissions resulting from use of improved engine control techniques and systems. Nineteen papers were presented at the conference, 17 of which are included in this report. Subjects of the papers include: the limits of automobile fuel economy; alternative emission standards for light-duty vehicles; effects of engine control variables on spark-ignition engine fuel economy and emissions; the constraints on engine-control systems; engine-calibration strategies for emission control; optimum automotive engine efficiency and emissions; a fluidic fuel-injection system utilizing air modulation; programmed and adaptive engine controls; transient control of air/fuel ratio in the spark ignition engine; transient response of a carburetor engine; closed-loop control of spark timing; the effect of ultralean air-fuel mixtures on automobile fuel economy with emission constraints; ultralean spark ignition engine operation; the fuel-economy potential of three late-model automobiles; turbulent flow manifolds and their application; a comparison of the lean-burn engine with several other near-term systems in terms of emissions, economy, and cost; microprocessors in automobiles; future power plants with respect to the ecology and fuel economy.

by Wolfgang V. Roessler, comp.
Department of Transportation, Transportation Systems Center, Kendall Square, Cambridge, Mass. 02142
Rept. No. DOT-TSC-OST-76-15; 1976; 382p 156refs
Sponsored by the U.S. Department of Transportation, Washington, D.C. 20590. Includes HS-018 961 through 018 976. Aerospace Corp., El Segundo, assisted in organizing the conference.
Availability: Corporate author

HS-018 961

AUTOMOBILE FUEL ECONOMY LIMITS

Material is presented as a basis for discussion on the limitations to attainable automobile fuel economy, the parameters which fix these limits, and current technological achievements with relation to these limits. Auto structure, roominess, curb weight in relation to roominess, curb weight in relation to safety, driving wheel work requirements, power plant output requirements, fuel economy limits, and upper fuel economy limits in a highway or urban schedule are considered. It is concluded that for prescribed auto interior dimensions, the most effective way to increase fuel economy is to reduce weight and power to weight ratio. Some results are indicated from research on the relationship between safety ratings and vehicle weight and the factors involved in propulsive parameters of operation. Given current technological accomplishment of fuel economy limits, it is considered essential to meet the problem of increasingly stringent fuel economy requirements directly in order to insure technical feasibility of future regulations for fuel economy.

by R. R. John
Department of Transportation, Transportation Systems Center, Cambridge, Mass.
Publ: HS-018 960, "Automotive Energy Efficiency Program," Cambridge, 1976 p1-22
1976
Presented at the Automobile Engine Control Symposium, Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 962

ENERGY IMPACT OF ALTERNATIVE EMISSION STANDARDS FOR LIGHT DUTY VEHICLES

Cost, fuel economy, and resulting energy impacts of various emission standards for light duty vehicles, 1977 through 1980, are discussed, and projections of fuel economy improvements are made. The 1980 new car fleet due in 1979 is used as the target fleet. Methodology used for projecting improvements includes definition of the base year, non-engine related fuel economy projections, determination of potential engine systems efficiencies and cost as related to emission standards, and prediction of energy use and consumer cost for different emission standards. Conclusions of the projective analysis are: increasingly stringent emission standards by 1980 will reduce fuel economy and raise prices; significant limitations in technological and production improvements for increased fuel economy and emission reduction exist; the 1980 state-of-the-art engine will be similar to present engines in basic operation, but with some technological improvement in control systems for engine variables; fuel economy penalties projected ensue independently of maximum feasible sales mix shift to smaller cars; data on sulfuric acid emissions from catalyst equipped cars are incomplete; statutory oxides of nitrogen level effectively prohibits development and production of diesel and stratified charge engines; a federally supported engine test data development program is recommended for aid in reducing

the uncertainty in potential for fuel economy and emissions performance of current engines.

by R. E. Goodson
Purdue Univ., West Lafayette, Ind.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p23-66
1976; 14refs
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 963

A REVIEW OF THE EFFECT OF ENGINE CONTROL VARIABLES ON SPARK IGNITION ENGINE FUEL ECONOMY AND EMISSIONS

Effects of spark-ignition engine control variables on brake specific fuel consumption (BSFC) are examined, in order to identify variables which through engine optimization are likely to have a substantial impact on BSFC in a 5-10 year time frame. The importance of the constraints of hydrocarbon and nitrogen oxide emission levels and of octane ratings of available fuel are emphasized in this engine optimization process. It is shown that the engine and its associated emission controls can be analyzed as a system. Specific emission constraints likely to be in effect in the 1980-1985 period are reviewed, and the engine fuel economy penalties in the absence of significant improvements in technology at a series of emission levels are assessed. Three systems (a lean engine with a thermal reactor, a lean engine with catalyst, and a close-to-stoichiometric engine with exhaust gas recirculation and catalyst) are examined for the maximum gains which might be realized within the expected constraints. Gains of 11 to 22% are estimated, roughly offsetting anticipated losses due to required stricter hydrocarbon and nitrogen oxide control.

by J. B. Heywood; R. J. Tabaczynski
Massachusetts Inst. of Tech., Sloan Automotive Lab.,
Cambridge, Mass.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p67-122
1976; 35refs
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 964

CONSTRAINTS ON ENGINE CONTROL SYSTEMS

Controllable engine operating parameters which affect fuel economy of passenger car engines have been improved by means of various control strategies, with consideration given to the practical restraints on use of such engine control systems. Constraints on the application of such control systems in modern engines relate to fuel economy, vehicle emissions, engine knock, vehicle driveability, engine and control system durability, reliability, and stability; control system adaptability to varying environmental conditions; and manufacturing and cost/benefit factors. Some opposite orientations are reviewed with regard to the relationship of these constraints to government and consumer interests. Safety factors have also been considered in optimization studies of the systems. It is concluded that optimization of the spark ignition engine/vehicle system through improved control systems is a necessary effort in searching for improved vehicle efficiency,

but the restraints discussed decrease technology utilization in some areas.

by W. G. Agnew
General Motors Res. Labs., Warren, Mich.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p123-32
1976
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 965

OPTIMIZATION OF AUTOMOTIVE ENGINE EFFICIENCY AND EMISSIONS

Initial results of an investigation into possibilities, both theoretical and practical, of employing optimal control theory in the task of automobile fuel and emission management are presented. Experimental curve fitting techniques are used to model engine emissions as a function of engine operating variables. Using this model, optimal control inputs for a given vehicle and specified test cycle are computed. Air-fuel ratio, spark advance, and exhaust gas recirculation were considered as the control variables. Results of the study show that considerable improvement over stock car performance can be obtained if these variables are optimally controlled. It is suggested that for actual hardware implementation purposes, closer approximations to experimental data could be obtained by narrowing the approximation range of operating variables.

by S. J. Citron; R. E. Goodson; R. Prabhakar
Purdue Univ., School of Mechanical Engineering, West
Lafayette, Ind.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p135-64
1976; 7refs
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975. Supported by the Office of Naval Res.
Availability: In HS-018 960

HS-018 966

OPTIMIZATION AND SCHEDULING OF ENGINE VARIABLES

The problem of optimization of functions subjected to constraints and its application to optimization of economy and emissions of the automobile engine are discussed. Repeating the optimization process over the entire range of engine operation yields optimum schedules of operational variables or optimum values of engine parameters. It is shown that the selection of the constraints has a profound effect upon the resulting schedules. Specifically, it is shown that the correct constraints yield a true optimum; whereas, the wrong constraints yield a false optimum operation for economy. A similar result for optimizing emissions is established. It is concluded that for economy the general optimization method is to minimize fuel consumption for a fixed load speed and torque, and an alternative method is suggested. The reasoning of optimum scheduling has led to new concepts in control of engine variables, such as the optimizer timing control and prescheduled and optimizer air-modulated fuel injection. The method for optimizing exhaust emissions is given as minimizing the weighted sum of mass flow rates of emissions at a fixed speed and torque by varying air consumption, fuel consumption, and ignition tim-

ing. By optimizing specific economy or emissions, operation of an automobile over a given course will result in minimum fuel consumed or minimum pollution. It is further concluded that by correctly optimizing input variables, improved emissions in relation to improved fuel economy can be realized with standard equipment. Diagrams illustrating engine variables used in scheduling and comparisons of optimum schedules with different constraints are included.

by R. L. Woods
University of Texas, Arlington, Tex.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p165-86
1976; 6refs
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 967

A FLUIDIC FUEL-INJECTION SYSTEM UTILIZING AIR MODULATION

A unique approach to fuel management systems applicable to spark-ignition engines is presented. In the air-modulation system described, the operator controls fuel consumption directly, and the control circuit schedules and controls air consumption. This approach is opposite to existing systems, and provides desirable inherent features that have to be built as auxiliary circuits on conventional systems. This approach to fuel management is also helpful in reducing emissions and increasing driveability, and is well suited for fluidic control. The bench-test results of such a prototype system are presented. A review of previous fluidic fuel management projects is also given. The present system described is judged superior in filtering out high-frequency noise, having less sensitivity to variations in the controlled parameter, being less complex due to inherent functions that would normally be add-on circuits, and being self-purging through fuel vaporization. It is concluded that the air-modulation system shows promise for meeting limits of economy, emissions, and driveability.

by R. L. Woods
Harry Diamond Labs., Fluidic Systems Res. Branch,
Washington, D.C.
Publ: HS-018 960 "Automotive Energy Efficiency Program,"
Cambridge, 1976 p187-96
Rept. No. 73-WA/Flcs-3; 1976; 44refs
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960; ASME \$3.00

HS-018 968

ENGINE CONTROLS: PROGRAMMED AND ADAPTIVE

Five control systems, programmed and adaptive, for the control of engine air-fuel ratio have been compared for accuracy. Three systems feature programmed controls, one an error-correcting feedback control, and one an optimizing control. Control accuracy was considered in terms of manufacturing tolerances, drift in use, non-sensed parameters, false substitutes, and wrong targeting. A quantitative analysis has been made on the control systems for the mixture ratio of spark ignition engines to indicate their accuracy ranges, with application to electronic fuel injection systems. Practical as well as optimal aspects of mixture control systems are discussed, as-

sessing the relative importance of production costs, maintenance requirements, durability, convenience, emissions, and economy. The system featuring extremum-seeking or optimizing control was found to be superior to other systems studied in accuracy, simplicity, and production cost, indicating its overall acceptability as the current system of choice.

by P. H. Schweitzer
Optimizer Control Corp., State College, Penn.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p197-218
1976; 15refs
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 969

TRANSIENT CONTROL OF AIR/FUEL RATIO IN THE SPARK IGNITION ENGINE

The effect of air/fuel ratio on the operation of the spark ignition engine is reviewed. An air/fuel ratio control system for this type of engine based on a unique ion drift air flow sensor is described. The system provides transient control of air/fuel ratio on a cylinder to cylinder basis during conventional driving with an accuracy comparable to that achieved in premixed homogeneous mixture laboratory equipment. This control allows operation near the true engine lean limit. Pollutant control, with high fuel economy and highly responsible performance, can thus be realized by use of the control system described.

by E. J. Durbin
Princeton Univ., Dept. of Aerospace and Mechanical Sciences,
Princeton, N.J.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p219-28
1976
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 970

TRANSIENT RESPONSE OF A CARBURETOR ENGINE

The transient response of a carburetor engine was studied experimentally, taking the throttle position as input and maximum cylinder pressure as output. Then transient response of the liquid fuel flowing along the inlet pipe was analyzed theoretically, and approximate theory was established. The study has shown that there are three types of maximum gas pressure responses in the combustion chamber of a single cylinder carburetor engine, according to initial mixture ratio. Since an inlet pipe can be regarded as a linear system for flow of liquid fuel, and its time constant is equal to the ratio of inlet pipe length to the mean velocity of liquid fuel, the transient responses for the engine can be predicted if values of pipe length, fuel velocity, and initial mixture ratio (rich, medi-

experimental and calculated transient response data.

by Munenobu Tanaka
Princeton Univ., Princeton, N.J.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p229-34
1976; 5refs
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 971

EFFECT OF ULTRALEAN AIR-FUEL MIXTURES ON AUTOMOBILE FUEL ECONOMY WITH EMISSION CONSTRAINTS

Engine efficiency and emissions options that are available in the ultralean range of air-fuel mixture ratios with otherwise conventional gasoline engines are described, based on data generated during design criteria development and emissions characterization for a lean-mixture engine induction system. The test engine was a standard domestic V-8 without exhaust-gas recirculation or exhaust-system emission controls. Conventional equipment for mixture generation, air intake, and fuel supply are described. The induction system utilized gave highly uniform time-averaged cylinder-to-cylinder air/fuel distribution, as shown by individual-cylinder emission measurements. Emissions data at constant speed and load, equivalent to 60 mph operation of an intermediate sized car, for various levels of fuel economy, are presented. It is shown that a wide range of efficiency and emissions levels are available in the lean-mixture operating range. Use of the system devised resulted in engine operation at about 18:1 air/fuel ratio at cruising speeds, and provided a high degree of emission control with near-maximum efficiency. Improvements for the system to enable its application in conventional equipment are suggested.

by F. A. Creswick
Battelle, Columbus Labs., Columbus, Ohio
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p253-8
1976
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 972

TOWARD ULTRALEAN SPARK IGNITION ENGINE OPERATION

Research directed toward the improvement of ultralean spark ignition engine operation is reviewed. Studies on exhaust emission control as related to lean fuel/air ratio are recounted. Factors relating to emissions control which were studied included homogeneous lean mixtures, extension of the lean limit of conventional engines, and cycle-by-cycle variations in combustion phenomena. The cause of cycle-by-cycle variations was sought in the initiation and early stages of combustion, concentrating on the initial portion of the energy release process. Experiments performed to characterize the phenomena of the energy release process were carried out, and a hypothesis was formulated to account for variations in initial burn. The hypothesis explained variations in combustion phenomena by means of velocity regions in the combustion chamber which can com-

ignite. A hypothesis was developed and tested. Results indicated that order to extend the lean limit of conventional engines, the gas motion in the vicinity of the spark plug at the instant the spark passes must be so modified as to make the initial burn duration as uniform and short as possible. Equalization and shortening of the initial fuel burn duration were accomplished in test engine apparatus by various mechanical means. It is concluded that such improvements through hardware design and utilization can significantly reduce emissions while improving fuel economy. Graphs and diagrams are included which illustrate significant points made in the discussion.

by S. S. Lestz; W. E. Meyer
Pennsylvania State Univ., Dept. of Mechanical Engineering,
University Park, Penn.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p259-88
1976; 12refs
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 973

TURBULENT FLOW MANIFOLDS AND THEIR APPLICATION

The design and application of turbulent flow manifolds (TFM) for improvement in lean engine operation are discussed. These improved intake manifolds are modifications of production manifolds and employ production carburetors set to give lean mixtures. The TFM incorporates two features: a mixing tube which extends from the carburetor flange through the bottom of the intake manifold and a conditioning box located below the floor of the manifold where the heavy fuel droplets are separated and vaporized. Maximum cylinder-to-cylinder spread with the TFM is less than one half air/fuel ratio, a typical improvement of about two-thirds compared with the engines before modification. The TFM has been installed on 4-, 6-, and 8-cylinder cars using 1-, 2-, and 4-barrel carburetors. Both exhaust gas and engine coolant have been used to heat TFM. All the cars met the 1975 Federal emission standards without any after-treatment devices. A water table study was conducted to determine optimum design and configurations for TFM. Historic relationships of compression ratio to fuel economy have been verified down to emission levels below the 1975 California levels.

by R. M. Olree
Ethyl Corp., Detroit, Mich.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p291-328
1976; 11refs
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975. Includes "Lead-Compatible Emission Controls--A Route to Improved Fuel Economy," by W. E. Adams, F. J. Marsee, and D. L. Lenane (NPRA-Paper-F&L-74-60).
Availability: In HS-018 960

EMISSIONS, ECONOMY, AND COST--A COMPARISON OF THE LEAN BURN ENGINE WITH SEVERAL OTHER NEAR-TERM SYSTEMS

A comparison is made of the lean burn engine with several other near-term systems in aspects of emissions, economy, and cost. Dissatisfaction with use of an oxidation catalyst because of higher initial cost, higher sulfate emissions, and questionable durability has led to the search for viable options to effect the same degree of emission control at an improved cost level. It is proposed that the lean burn engine system is the near-term system with lowest overall cost that is capable of meeting Federal and California 1975 standards. Advantages of lean operation with regard to brake specific fuel consumption, and emissions are demonstrated. Several different systems are available with the objective of achieving an air/fuel ratio of over 20:1. Three such systems are described and compared: the ethyl system featuring high velocities for better atomization; the Shell Vapipe using exhaust heat for fuel vaporization; and the Dresserator using a supersonic variable throat nozzle. Test data show that the lean burn system offers potential for emission control to at least 75 levels at costs lower than catalyst systems, with attendant fuel economy predicted.

by J. E. A. John
University of Toledo, Toledo, Ohio
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p329-42
1976
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 975

MICROPROCESSORS IN AUTOMOBILES

The development and applications for microprocessors in automobiles are reviewed. The RCA Laboratories' work in microprocessing as applied to automotive electronics has been concerned with engine control, braking control, transmission control, solid state sensors, driver displays, power actuators, and radar braking. Viewgraphs representing the systems discussed are presented.

by G. B. Herzog
RCA Labs., Princeton, N.J.
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p343-62
1976
Oral presentation made at the Automobile Engine Control Symposium, Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 976

SYSTEMATIC OVERVIEW OF VARIOUS FUTURE POWER PLANTS WITH SPECIAL RESPECT TO ECOLOGY AND FUEL ECONOMY

A systematic overview of future powerplants with respect to ecology and fuel economy is given. A special systems analytical method has been developed and applied to a 2200 lb. sub-compact car, demonstrating the relationship which car weight has with fuel economy. The system calculates the techni-

product value developed, necessary research and development outlay, and feasibility of the respective powerplant then yield a decision basis. Investigations using the system were performed on the Otto, diesel, and stratified charge engines, utilizing the gas turbine, Stirling engine, and internal continuous combustion engines as test powerplants. Results show superiority of conventional concepts for powerplant design over advanced systems until at least 1990 when fuel availability and technological advancement may change the viewpoint. In particular it is concluded that there is special potential in development of light weight diesel engines.

by P. Hofbauer; B. Wiedemann
Volkswagenwerk, A.G., Res. Div., Federal Republic of West Germany
Publ: HS-018 960, "Automotive Energy Efficiency Program,"
Cambridge, 1976 p363-78
1976; 1ref
Presented at the Automobile Engine Control Symposium,
Cambridge, 8-9 Jul 1975.
Availability: In HS-018 960

HS-018 977

ESTIMATING THE EFFECTS OF URBAN TRAVEL POLICIES. FINAL REPORT

Models and procedures for quick evaluation of transportation policy options on urban travel behavior are presented. The methods described can be used to estimate the travel demand effects of a wide variety of transportation policy instruments with currently available data in a matter of hours, or minutes, with the aid of a calculator. To evaluate the effects of a transportation policy, travel is separated into work and nonwork purposes. The work travel section describes procedures for applying disaggregate logit models to generally available grouped data. To analyze the effects of policies on nonwork travel, a disaggregate travel demand model is estimated which is designed to be broadly applicable to a variety of planning and data contexts. Both the work and nonwork trip demand models and procedures are exercised on sets of policy issues which are of current interest, including gasoline taxes, parking restrictions, transit service improvements and the introduction of new modes. Where appropriate, travel-demand elasticities with respect to level of service changes are computed. A review of existing data and behavioral demand models is included - a critique of existing models is presented. Thirty-seven tables present data associated with the discussion.

by Frederick C. Dunbar
Charles River Associates, 1050 Massachusetts Ave.,
Cambridge, Mass. 02138
Contract DOT-TSC-964
Rept. No. DOT-TSC-OST-76-10; 1976; 196p 36refs
Rept. for Feb 1975-Mar 1976.
Availability: NTIS

HS-018 979

REDUCING IMPULSE NOISE IN CB TRANSCEIVERS

Techniques used for reducing electrical impulse noise in two-way amplitude modulated (AM) radio equipment, as they apply to the design of transceivers used in the Class D Citizens Radio Service at 27 Megahertz (MHz), are described. Costs to the customer are given for these various techniques.

Noise is undesirable because it reduces communication range, annoys the listeners, induces operator fatigue and creates dissatisfaction with the product. Noise reduction techniques used for impulse noise reduction in CB transceivers include automatic gain control rolloff, squelch, automatic noise limiter, noise blankers, filtering of the battery supply line, tone operated squelch. The cumulative cost of combined techniques is \$19.70.

by John W. Foster
E. F. Johnson Co.
Rept. No. SAE-760277; 1976; 11p 12refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-018 980

AUTOMOTIVE MANUFACTURING AND MAINTENANCE. INTERIM REPORT. (PART 2) APPENDIX A-H

A thorough discussion of automotive manufacturing companies is presented. Profiles of 4 American manufacturers, GM, Ford, Chrysler, and American Motors discussing sales, part production, locations of manufacturing capabilities, capital expenditures and future plans are presented. Automotive production outside the U.S. and Canada is outlined by producer. A table of machine tooling companies, their locations and capabilities is included. The material requirements of various American-made automobiles is presented in tabular form and energy requirements for production of the materials are included. The impacts of changes in the casting, forming, heat-treating, machining, joining, assembling and finishing processes are discussed. Seven pages of tables show various American assembly lines, their locations and models produced. Summary reports for various size classes of automobiles list cost of production for each part, and eventually tally the cost for the class of automobile to the manufacturer. The change in materials content for a front-wheel drive vehicle with an aluminum engine, a body partially of plastic, and some heavier metal parts replaced by aluminum, concludes the report.

Panel on Automotive Manufacturing and Maintenance
Interagency Task Force on Motor Vehicle Goals Beyond 1980
1976; 178p 44refs
Part 1 is HS-019 168.
Availability: Office of Secretary of Transportation,
Publications Section, TAD-443.1, Washington, D.C. 20590

HS-018 981

FUELS AND MATERIALS RESOURCES FOR AUTOMOBILES IN THE 1980-1990 DECADE. REPORT OF A PANEL OF THE INTERAGENCY TASK FORCE ON MOTOR VEHICLE GOALS BEYOND 1980. INTERIM REPORT

Issues associated with the availability of fuels and materials have been examined and analyzed by the Fuels and Materials Resources Panel of an interagency task force commissioned to consider goals for motor vehicle fuel economy beyond 1980. Agencies with interests in fuels, energy, transportation, and the environment participated. Major findings of the fuels and materials panel are presented and discussed. Regarding the resource base for fuels, it is established that domestic crude production will be inadequate to meet expected transportation

and other energy needs, and there will be continued reliance on imported crude. Synthetic liquid fuel development is expected to be available within the time frame analyzed, but dependent on policy formation and implementation for development. World crude resources are sufficient to meet projected world demand through the year 2000, with dependency on political factors indicated. Automobile fuel through the year 2000 will be primarily conventional hydrocarbon liquid, although some feasible alternatives are available. With regard to price and sensitivity to demand, gasoline or distillate availability is projected for pump prices, motor fuel manufacturing cost dependencies, and distillate fuel prices. With regard to the impact of change from traditional fuel usage, it is estimated that the petroleum refinery industry, in the aggregate, consumes energy equivalent to 8 to 12 percent of raw material stocks to produce its current product mix. One-half to two-thirds of total United States automotive fuel needs could be supplied as diesel fuel by the mid-1990s. Overall energy production and utilization factors were examined, such as process efficiency, refinery investment costs, and the impact of environmental consideration requirements. It is predicted that the normal growth of the automobile industry will be possible with adequate supplies of materials as projected. Production of alternate powerplants will introduce new material requirements, a need which is sensitive to the level of industrial and government commitment. The overall period of transition to alternative fuels and fuel byproducts is concluded to be highly dependent on political and policy developments. A summary of terms used in the publication is included as Appendix G.

by Richard Hurn, Chm.
The Panel on Fuels and Materials Resources for Automobiles in the 1980-1990 Decade, Interagency Task Force on Motor Vehicle Goals Beyond 1980
1976; 161p 66refs
Availability: Department of Transportation, Publications Section, TAD-443.1, Washington, D.C. 20590

HS-018 982

ELECTROMAGNETIC RADIATION REGULATION IMPACT ON A MANUFACTURER OF SMALL INTERNAL COMBUSTION ENGINES

Complex problems are described which manufacturers of small internal combustion engines must face if Electromagnetic Radiation standards are set and Regulations are put into effect on all spark-ignited internal combustion engines. Discussed are effects which EMR regulation will have on manufacturers, users, taxpayers, and regulators. Definition and documentation of the manufacturer, as well as the consumer, the taxpayer, and the regulator, are discussed. Considered is the need for EMR regulation, and whether imposing specific controls on all small IC engines, regardless of their applications and usage, will meet that need in the world. Regulation of Electromagnetic Radiation - when it becomes mandatory on small internal combustion engines - will increase manufacturers' costs. Design changes and the introduction of hardware to control EMR will have direct effect on product costs. Indirect, overhead cost increases will be due to: buying, operating and maintaining specialized measuring equipment; purchasing and setting up special sites for evaluating and development work; hiring and training of highly skilled personnel; performing certification tests requiring longer development and procurement lead times because every model of every product (application) must

tested and developed separately. Consumers who use the great variety of engine-driven products will be affected in at least three ways: first, a direct increase in product price, reflecting manufacturers' cost increases; second, the higher cost of servicing and maintaining products in "factory quiet" (RFI) condition; and third, probable penalties in performance, weight, bulk, and ease of handling. A final, but significant burden will be shared by all taxpayers - the cost of enforcement. If regulations are not uniformly and fairly enforced, original equipment will be allowed to deteriorate. Lack of uniform and complete enforcement could result in unfair competition and loss of improved communication for all those who were expected to benefit from reduced EMR.

by R. H. Lincoln; D. H. Wood
Outboard Marine Corp.
Rept. No. SAE-760276; 1976; 7p 4refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-018 983

NATIONAL, INDUSTRIAL AND CONSUMER ECONOMICS. INTERIM REPORT

Fuel economy goals for motor vehicles compatible with environmental, safety and economic objectives are considered. National, Industrial and Consumer economics are evaluated. It is concluded that a variety of opportunities exist for significantly improved fuel economy in the nation's auto fleet. It should be feasible to keep the total petroleum consumption by automobiles at or below its present level for the remainder of the 20th century while allowing for population growth and reasonable total petroleum consumed and thence either to reduction of oil import dependence or to extension of the life of domestic oil resources. A methodology does not exist for conducting a rigorous cost-benefit analysis of motor vehicle goals and impacts. Technological opportunities also exist to meet stringent emission standards, at or beyond the level of current (early 1976) statutory standards of .41/3.4/4, with good fuel economy. However, such a combination of low emission and high fuel economy requires the development of new technology engines and/or exhaust treatment devices with considerable cost and risk to industry and the economy. Advanced automobile construction techniques offer a possibility of improved crashworthiness and weight lower than present models. However, for any level of technology, increased structural strength implies a penalty in cost and fuel economy particularly noticeable in small cars. The major risk to the national economy comes through the potential for failure within the industry in an attempt to meet overly ambitious goals or the effects of adverse market response and business cycle fluctuation on an overextended industry. The impact on the national economy of successful programs to attain the motor vehicle goals is not likely to be severe on GNP, Consumer Price Index or unemployment. The overall industrial effect of successful programs is not likely to be severe for auto manufacturing, its suppliers or the aftermarket. Reductions in fuels and materials will result in cutbacks in those industries. Unsuccessful programs present a serious industrial risk.

Panel on National, Industrial and Consumer Economics
Interagency Task Force on Motor Vehicle Goals Beyond 1980
1976; 194p
Availability: Office of Secretary of Transportation,
Publications Section, TAD-443.1, Washington, D.C. 20590

HS-018 984

OBJECTIVES AND DESIGN OF THE ERDA/CHRYSLER UPGRADED GAS TURBINE ENGINE

Under a contract which began in Nov 1972, Chrysler Corporation has been conducting an automotive gas turbine improvement program for the Division of Transportation of the Energy Research and Development Administration. The final task of this program is to design, build, and demonstrate an Upgraded Engine. The design has been accomplished and is described in this paper. It utilizes a number of improvements developed and verified on the Chrysler Sixth Generation "Baseline" engines, e.g. variable inlet guide vanes, water injection, ceramic regenerators, an integrated electronic control system, a free-rotor arrangement, a low emissions fixed geometry burner, and linerless insulation. Aerodynamic details to meet higher efficiency component specifications were provided by NASA Lewis. The design also incorporates a gas bearing on the rotor and improvements in arrangement and mechanical design. A vehicle system incorporating this engine should operate with fuel economy double that of the Baseline engine system and demonstrate emissions levels within the current 1978 Federal Standards. Diagrams of the engine and graphs showing its performance are included.

by G. A. Ball; J. I. Gumaer; T. M. Sebestyen
Chrysler Corp.; Energy Res. and Devel. Administration
Rept. No. SAE-760279; 1976; 26p 10refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-018 985

SOCIAL AND ECONOMIC EFFECTS OF HIGHWAYS

The effects that modern highways have on individuals, communities, and regions are highlighted. A narrative portion synthesizes some of the experience gained in highway impact studies during the past 15 years. The report includes abstracts of studies completed during the past 5 years, a brief description of impact studies underway, and an index by author and research agency and by subject matter. Tentative conclusions on several aspects of highway experience are offered. For example, residents and businesses displaced by highway right-of-way are generally being relocated satisfactorily. However, residents in close proximity to highways may have noise, air pollution, or safety problems, and these disadvantages may be reflected in lower property values. Accessibility effects of highways, unlike proximity effects, are ordinarily positive. The benefits of highway accessibility often outweigh the disadvantages of highway proximity, even for residential property. Whether benefits or disadvantages occur near highways depends primarily on the land use involved. Industrial or commercial uses along highways ordinarily benefit. Some uses, such as residences, may be bothered by highway proximity. Some activities such as schools, churches, and hospitals may benefit enough from highway accessibility and visibility to justify locating near highways. Development near highways resembles the unsatisfactory situation in general land use planning except that conflicts near highways are more pronounced and wasteful. The apparent scarcity of freeway frontage compared with space needed for activities that

HS-018 986

AN EVALUATION OF REAR MOUNTED FOG WARNING LIGHTS FOR MOTOR VEHICLES

An evaluation of rear mounted fog warning lights for motor vehicles is presented. The project includes a comparative performance evaluation of a wide range of lamps in a fog simulation tank, subsequently confirmed by cross-calibration studies in real-life fog. The evaluation takes into account such factors as driver reaction, the photometric distribution of lamp output, source intensity, shape and size of lens and reflector. Results are compared with the equivalent sight distance of a conventional dipped headlamp and with conventional rear/stop lamp clusters. The study was intended to identify those features of lamp design which most influenced performance and included the characteristics such as lamp shape, reflector size and lens configuration and color. Each manufacturer would then be advised how his own proprietary lamps compared with the optimum, together with that information which he might most usefully use in future lamp development. Results show that in both static and dynamic tests greater illumination is most effective, area of emitted light surface should be between 90 square cm and 120 square cm, mounting height is critical, lamp configuration is important and that Lamp Model 0 performed well.

by R. G. Kinnear; D. M. Rose; A. R. King
Polytechnic of Central London, 35 Marylebone Rd., NW1 5LS, London, England
1973; 56p 9refs
Sponsored by Notek, Lita-lamps, Raydyot, Stadium, Wipac, and The Automobile Assoc.
Availability: Corporate author

HS-018 987

WOMEN ARRESTED FOR DRUNKEN DRIVING IN BOSTON. SOCIAL CHARACTERISTICS AND CIRCUMSTANCES OF ARREST

The hypothesis is tested that in the case of the woman DWI (drunk while driving) offender, the police officer tends not to complete the arrest procedure unless certain conditions, events, or behaviors (e.g. property-damage accidents, personal-injury accidents, or verbal or physical abuse of police) accompany the act of driving while intoxicated. A sample of 73 women was selected from the Boston Alcohol Safety Action Project (ASAP). These women had been arrested for DWI during the period Oct 1972-Feb 1975. Age, race, marital status, education, occupation, previous police and alcohol involvement, and circumstances of arrest were investigated in order to make a composite profile of the woman arrested DWI and referred to ASAP. She is a woman in her early 30's who is legally unattached and living alone. She has a job of relatively low-level skill, when employed, despite a slightly higher than average level of education. She is usually arrested during late-evening or early-morning hours as a result of a traffic violation, involvement in an automobile accident or abusive behavior. She is usually alone in the car and highly intox-

separation and previous involvement with the police in courts. The hypothesis concerning arrest procedures is proven and it is concluded that this tendency not to arrest weakens the DWI arrest as a mechanism for early detection of problem drinking.

by Milton Argeriou; Donna Paulino
Publ: Journal of Studies on Alcohol v37 n5 p648-58 (May 1976); 30refs
Availability: See publication

HS-018 988

A CAR-FOLLOWING SIMULATION MODEL

A mode which attempts to simulate the more significant characteristics of a car-following driver/vehicle system is described. The approach, which involves control system theory techniques, seems appealing for several reasons. The elements of the model correspond well with the elements of the actual driver/vehicle situation. For example, a threshold for the perception of closing rate is simulated by a deadband in the rate signal. Also, advantage can be taken of the techniques and experience developed over the last few decades in control system engineering. The model was implemented by a computer program which output time histories of driver/vehicle response to step perturbations. The major parameters which were varied were related to response time, perceptual threshold and sensitivities. More work is needed to make the car-following model more realistic. Two characteristics which should be substantiated by more field data are deadband and the possibility of a low-frequency oscillation in commanded following-distance. Another characteristic is present in most vehicle/driver systems: the self-adaptability which revalues the system gains and other parameters if necessary. It is felt that the modelling approach described in this paper has potential value. An important application of a car-following model is in the simulation of a platoon of vehicles. A platoon can be simulated by linking up a number of following models behind one lead vehicle. Parameter values for the computer runs are tabulated and graphs of responses to step position error of 20 feet for the tabulated cases are included.

by F. H. Lloyd; D. L. Gerlough
Publ: Traffic Engineering and Control v17 n5 p211-5, 217 (May 1976)
1976; 14refs
Availability: See publication

HS-018 989

IMPROVING FUEL VAPORIZATION

Providing a virtually homogeneous fuel-air mixture delivery to the cylinders of a spark-ignition engine, a problem of long standing, is now being accomplished by a device being developed by engineers at the Shell Research Ltd., Thornton Research Centre (England) and the National Engineering Laboratory (Scotland). The "Vapipe," as it is called, achieves the improved mixing by vaporizing the gasoline in the intake system with heat from the exhaust. The unit is compact enough to fit in the engine compartment. Further development is needed, however, to adapt the design to low-cost mass production and to prove its reliability. Prototype Vapipe has been tested on test-bed engines, in cars on the road, and

chassis dynamometers. The results indicate that the gasoline is so completely vaporized and mixed with air that engines run smoothly at air-fuel ratios substantially leaner than 18/1, thereby providing both better fuel economy and lower exhaust emissions. Reduced warmup time and significant improvements in driveability and flexibility are also attained. The only penalties appear to be somewhat reduced power output.

Publ: Automotive Engineering v84 n6 p37-42 (Jun 1976)
1976

Based on SAE-760564, "The Vapipe-A Practical System for Producing Homogeneous GASOLINE-AIR MIXTURES," by G. A. Harrow, W. D. Mills, A. Thomas, L. C. Finlay, and presented at SAE Fuels and Lubricants Meeting, St. Louis, 8-10 Jun 1976.

Availability: See publication

HS-018 990

MORE MPG FOR TRACTOR-TRAILER RIGS

Simple aerodynamic devices added to existing tractor-trailer combinations could save 2400 gal of diesel fuel per 100,000 miles of operation. The add-on devices consist of a fairing mounted on the tractor roof and a flexible membrane sealing the gap between the tractor and the trailer. A substantial part of the aerodynamic drag on tractor-trailer trucks arises because of the unstreamlined manner in which the flow, after having passed beyond the tractor, moves around the trailer. Depending on the particular combination of tractor, trailer, and gap width, this drag may represent as much as one-third of the total aerodynamic drag on a cab-over-engine tractor-trailer moving in still air. Inservice tests show that: aerodynamic add-ons significantly reduce drag, confirming the logic outlined above; the streamlined fairings reduced drag more than did the wind deflector, in both wind tunnel and full-scale tests; adding the devices to prevent crossflow through the gap between tractor and trailer reduced drag even more, at least in the full-scale tests; and the University of Maryland (Type C) fairing/gap seal combination consistently reduced drag more than the commercial wind deflector/vortex stabilizer.

Publ: Automotive Engineering v84 n6 p44-9 (Jun 1976)
1976

Based on SAE Papers 760105, "An Evaluation of the Aerodynamic Drag Reductions Produced by Various Cab Roof Fairings and a Gap Seal on Tractor-Trailer Trucks" by C. H. Marks, F. T. Buckley, Jr., and W. H. Walston, Jr., Univ. of Maryland; 760106, "Test Procedure for the Evaluation of Aerodynamic Drag on Full-Scale Vehicles in Windy Environments" by W. H. Walston, Jr., F. T. Buckley, Jr., and C. H. Marks, Univ. of Maryland; 760107, "Analysis of Coast-Down Data to Assess Aerodynamic Drag Reduction on Full-Scale Tractor-Trailer Trucks in Windy Environments" by F. T. Buckley, Jr., C. H. Marks, and W. H. Walston, Jr., Univ. of Maryland; plus other information furnished by these authors. Papers presented at 1976 SAE Automotive Engineering Congress, Detroit, 23-27 Feb.

Availability: See publication

HS-018 991

THE DIESEL ENGINE: TODAY AND TOMORROW

Recent advances in diesel technology and future possibilities are presented. Turbocharging and after cooling of engine air are two recent advances which have improved the engine's efficiency. De-rating lowers fuel consumption with some overall

speed loss, particularly on grades. De-rating also increases engine longevity. Fewer transmission speeds have resulted in fewer shifts and, therefore, less fuel consumption. Durability of the engine has improved. Improved emissions can be achieved by recirculating exhaust gases with resultant reduced engine efficiency. Improvement of injection pressures, turbochargers, durability and reliability of engine parts, and meeting pollution standards are future advances which are expected.

by Larry Givens, ed.

Publ: Automotive Engineering v84 n6 p30-4 (Jun 1976)
1976

Availability: See publication

HS-018 992

VEHICLE BARRIER SYSTEMS (ROADSIDE SAFETY DEVICES)

An analytical modeling technique to simulate possible rollover vaulting of heavy vehicles impacting traffic railings; calculation procedures to assess the potential of proposed designs of flexible bridge railings; effects of friction at the car-barrier interface in angular collisions by using scale-model techniques; an energy absorbing bridge rail using the plastic deformation of steel rings; strong post guardrail tests in which three post designs are compared; pendulum tests of a single breakaway sign support leg using rigid and crushable pendulum striking faces; the construction of an energy absorbing bridge rail using frangible tubes as the primary energy absorber and four tests with wire sand inertia barriers are topics covered in this Record.

by Joan B. Silberman, ed.

Transportation Res. Board, National Res. Council, 2101 Constitution Ave., N. W., Washington, D.C. 20418

Rept. No. TRR-566; 1976; 88p

Includes HS-018 993 to HS-019 000.

Availability: Corporate author \$6.00

HS-018 993

ROLLOVER-VAULTING ALGORITHM FOR SIMULATING VEHICLE-BARRIER COLLISION BEHAVIOR

A rollover algorithm for simulating vehicle-barrier collision behavior is presented. Because of the relatively high center of gravity of most heavy vehicles, the possibility of rollover vaulting is always present when a heavy vehicle collides with a median or bridge barrier. There have been various investigations made on vehicle-barrier response using simulation models that are either too simplified or extremely costly to run. The algorithm developed in this paper incorporates a comprehensive, three-dimensional model of the vehicle-barrier interaction and is very inexpensive to operate. In this algorithm, the vehicle-barrier interaction is assumed to take place in three phases: (a) the initial impulsive impact with the barrier; (b) a continuous, nonimpulsive translational and angular motion during redirection; and (c) a second impulsive impact when the rear of the vehicle swings around and strikes the barrier. The algorithm enables the user to monitor all the important vehicle dynamic parameters, including the angular orientation of the vehicle during redirection and the magnitude of the initial impulsive impact forces between vehicle and barrier. The program is applied to investigate the vaulting potential of pas-

senger and heavy vehicles with various barriers at speeds and impact angles covering the expected range. The RVA program (rollover vaulting algorithm) can be used to investigate the possibility of rollover vaulting for various vehicle-barrier combinations and should be used as a tool for quickly estimating the vaulting potential during vehicle-barrier interaction. Its findings should not, however, be taken as rigid guidelines without proper verification through full-scale testing.

by J. J. Labra; James Rudd; J. Ravenscroft
ENSCO, Inc., Springfield, Va.
Publ: HS-018 992 (TRR-566), "Vehicle Barrier Systems,"
Washington, D.C., 1976 p1-12
1976; 9refs
Availability: In HS-018 992

HS-018 994

SIMPLIFIED CRITERIA FOR EVALUATING FLEXIBLE BRIDGE RAIL PERFORMANCE

Simplified criteria are derived for evaluating the capability of a flexible bridge railing system to safely contain impacting vehicles ranging in size from subcompacts to heavy trucks. The evaluation is based on comparison of the static force versus deflection characteristic of the railing system with an associated integral characteristic that is easily obtained. The criteria have been applied to typical high-performance bridge railing designs such as the collapsing ring barrier and another hybrid barrier system. The barrier performance predicted by the simplified criteria agrees well with the dynamic results obtained from full-scale tests and computer simulations. The simplified criteria should prove valuable to the highway engineer in evaluating current and proposed designs of flexible bridge railings and in providing a guide to design improvements if required.

by Clarence Cantor; Jeffrey Bloom
ENSCO, Inc., Springfield, Va.
Publ: HS-018 992 (TRR-566), "Vehicle Barrier Systems,"
Washington, D.C., 1976 p13-22
1976; 5refs
Availability: In HS-018 992

HS-018 995

SCALE-MODEL EVALUATION OF FRICTIONAL EFFECTS AND REDIRECTION MECHANISMS FOR ANGLE BARRIER IMPACTS

The effects of friction at the car-barrier interface in angular collisions have been investigated by using a 1/24 scale model. Results demonstrate that interface friction can have a great effect on both vehicle trajectory and predicted damage to car and barrier. Friction thresholds for successful redirection are related to vehicle and barrier stiffness, impact angle, and impact speed, but low-friction values show promise of improving accidental barrier impacts at all speeds and angles tested. The study implies that redirection appurtenances should be designed for low values of vehicle interface-surface friction. A

picture of the model and graphs of the test results are included.

by Brent R. Helm; Joseph C. Free; Charles Y. Warner; Greg B. Frandsen
Brigham Young Univ., Dept. of Mechanical Engineering;
Eyring Res. Inst.
Publ: HS-018 992 (TRR-566), "Vehicle Barrier Systems,"
Washington, D.C., 1976 p23-30
1976; 18refs
Availability: In HS-018 992

HS-018 996

DEVELOPMENT OF A NEW COLLAPSING-RING BRIDGE RAIL SYSTEM

An energy-absorbing bridge rail system that uses the plastic deformation of steel rings as the primary impact energy absorber has been developed through full-scale crash testing and the use of the BARRIER VII computer program. The system design not only is capable of withstanding impacts by large vehicles such as buses and trucks but also does not impart high accelerations to impacting smaller vehicles. Ten full-scale crash tests were performed with vehicles ranging from 2,000 to 40,000 lb (907 to 18 144 kg). Redirection of high-speed (55 mph (89 km/h)), 40,000-lb (18 144-kg) vehicles (articulated and nonarticulated) impacting at a 19-deg angle was demonstrated. No significant elastic rebound of the rails and energy-absorbing rings was evident during the test. Vehicle damage was limited to mostly sheet metal damage of the impacting front quadrant and side panels with limited suspension damage at the same quadrant. Bridge rail damage ranged from slight for the subcompact vehicle impact to extreme for heavy vehicle impacts. Tests were documented by strain gauge, vehicle accelerometer, and high-speed movie data as well as permanent deformation measurements. Engineering diagrams for construction of barrier and pictures of a full size range of test vehicles before and after test procedures of full-scale angular crash tests are included.

by C. E. Kimball; M. E. Bronstad; J. D. Michie; J. A. Wentworth; J. G. Viner
Southwest Res. Inst.; Federal Hwy. Administration
Publ: HS-018 992 (TRR-566), "Vehicle Barrier Systems,"
Washington, D.C., 1976 p31-43
1976; 3refs
Availability: In HS-018 992

HS-018 997

DYNAMIC TESTS OF METAL BEAM GUARDRAIL

The results of four vehicle impact tests into metal beam guardrail using three types of posts and blocks are reported. The then current (1971) California standard plans for metal beam guardrail required 8 by 8-in. (203 by 203-mm) nominal douglas fir posts and blocks. A test objective was to determine whether smaller sized wood posts and blocks could be used and whether steel posts and blocks could be used in place of the 8 by 8-in. (203 by 203-mm) blocks to reduce guardrail costs. Testers also wanted to obtain another permissible post material besides wood. It was concluded that 6 by 8-in. (152 by 203-mm) nominal douglas fir wood posts and blocks were an acceptable substitute and that wide-flange 6-in. by 8.5-lb/ft (152-mm by 12.7-kg/m) steel posts and blocks could be used provided W-section backup plates were used at alternate posts where no beam splice occurred and a positive connection was

used at the end-anchor cable in place of cable clips. All four tests conducted used 4,960-lb (2250-kg) passenger vehicles with nominal impact speeds and angles of 65 mph (105 km/h) and 25 deg respectively. Engineering diagrams of the test barrier design are included.

by E. F. Nordlin; J. R. Stoker; R. L. Stoughton
California Dept. of Transportation, Div. of Construction and Res.

Publ: HS-018 992 (TRR-566), "Vehicle Barrier Systems,"
Washington, D.C., 1976 p44-55
1976; 11 refs
Availability: In HS-018 992

HS-018 998

PENDULUM TESTS USING RIGID AND CRUSHABLE BUMPERS

A test program is discussed in this paper consisting of 19 tests of a break-away sign support using a 2,000-lb (907-kg) pendulum mass impacting the support at 20 mph (32 km/h). Use of both rigid and crushable bumpers permitted examination of these techniques compared with current momentum-change criterion. In addition, the effects of bolt-tightening torque on the slip-base release loads were investigated. Hi-Lok frangible nuts, which control tightening torque, were also evaluated for the design torque condition. Only in the crushable bumper tests were dramatically different results obtained for the various nut-tightening torques when momentum change was used as the criterion. Momentum change with the hard bumper was 65 0/- 15 lbf-sec (289 0/- 67 N-s) for all base-nut torque levels. Momentum change with the crushable bumper ranged from 88 lbf-sec (391 N-s) for design torque condition to 398 lbf-sec (1770 N-s) for the overtorqued condition. Repeatability of slip-base loads was generally good when both a calibrated torque wrench and the Hi-Lok torque control nuts were used. It was concluded that momentum-change criterion is insufficient in evaluating results of pendulum tests using a rigid bumper. Use of a bumper with vehicle crush characteristics appears to provide a superior experimental evaluation. Photographs of test procedures are included.

by M. E. Bronstad; J. D. Michie; R. R. White
Southwest Res. Inst.; Hi-Shear Corp.
Publ: HS-018 992 (TRR-566), "Vehicle Barrier Systems,"
Washington, D.C., 1976 p56-64
1976; 3 refs
Availability: In HS-018 992

HS-018 999

CONSTRUCTION OF FRANGIBLE-TUBE, ENERGY-ABSORBING BRIDGE BARRIER SYSTEM

The Connecticut Department of Transportation in cooperation with the Federal Highway Administration installed a frangible-tube, energy-absorbing bridge barrier system. The experimental barrier absorbs the impact forces of a colliding vehicle by using fragmenting aluminum tubes. This paper details the construction of the experimental barrier on a Connecticut bridge having concrete parapet walls. The operating principle of the SwRI (Southwest Res. Inst.) design is based on the fragmentation of a series of aluminum tubes secured between a rigid bridge railing and a movable box beam. On impact between a vehicle and the box beam, the kinetic energy is absorbed in the fragmenting tubes at a rate that prevents the development of reaction force and that thereby reduces the possibility of

the vehicle rebounding back into the traffic stream (1). Modifications were made to the SwRI system before installing the bridge barriers in Connecticut. The test sight is described and construction details of core drilling and installation discussed. The work took 22 1/2 days to install the rail on a 852.8 foot bridge. Photographs of the components and installed unit are included. Construction of the frangible-tube barrier system, as designed by SwRI and modified by Connecticut DOT (for Connecticut's needs) indicates that, with minor changes in design, the system can be installed without encountering major problems. In addition, the system has pleasant aesthetic features and blends in well with its environment.

by Michael M. Kasinskas; Charles E. Dougan
Connecticut Dept. of Transportation
Publ: HS-018 992 (TRR-566), "Vehicle Barrier Systems,"
Washington, D.C., 1976 p65-8
1976; 1 ref
Availability: In HS-018 992

HS-019 000

TEST AND EVALUATION OF A TIRE-SAND INERTIA BARRIER

An inexpensive vehicle impact attenuator composed of scrap tires and sand has been developed and tested at the Texas Transportation Institute. This inertia barrier uses a base that is crushable, plywood disks, scrap tires, sand, and a weather-proof covering. The principle of the conservation of momentum is used in the design. In addition, curves have been developed to assist the designer. Many rigid obstacles located on highways cannot be removed or made to break away and consequently are hazardous to motorists. Vehicle impact attenuators have been developed to protect the public from these obstacles. Most of these attenuators are expensive, and some obstacles remain unprotected since available funds are directed to protecting more cost-effective locations. The research in this paper indicates that the tire-sand inertia barrier would be an economical and effective crash cushion for use in front of rigid obstacles along the roadside where the scattered sand and tires are not likely to fall on the paved roadway. The estimated total installed cost of the tire-sand inertia barrier is approximately \$800 when the barrier is installed by state employees. Diagrams describing barrier construction and pictures of the barrier and test vehicle before and after test procedures are included.

by E. L. Marquis; T. J. Hirsch; J. F. Nixon
Texas A&M Univ., Texas Transportation Inst.; Texas State Dept. of Hwys. and Public Transportation
Publ: HS-018 992 (TRR-566), "Vehicle Barrier Systems,"
Washington, D.C., 1976 p69-79
1976; 9 refs
Availability: In HS-018 992

HS-019 001

POWERED VEHICLES AND THE DISABLED DRIVER

In England, powered vehicles are available for the disabled. There, these persons may be provided with a powered three-wheel vehicle. This has the advantages of a wide door and a seat that slides from the side to the middle, but the disadvantage of being only a one-person vehicle, being less crash resistant, less mechanically reliable, and more susceptible to cross winds than regular production cars, and being a conspicuous vehicle that separates the disabled from the rest of

the community. A few of the disabled in England qualify for cars which can be modified, frequently by conversion to hand controls, to enable them to drive. Disabled drivers in England can obtain insurance, a car adapted for disabled passengers may be exempted from vehicle excise duty, and many areas use the orange badge scheme to give the disabled special parking exemptions. A provision aimed at providing a suitably adapted car or a mobility grant for the patient to make his own arrangements for a suitable vehicle is recommended rather than providing the three-wheel vehicles. Larger driving assessment centers are also needed.

by C. J. Goodwill

Publ: Proceedings of the Royal Society of Medicine v67 p416-9 (May 1974)

1974; 1ref

Availability: See publication

HS-019 002

CHANGES IN FATAL AND NONFATAL CRASH RATES ON A TOLL HIGHWAY

Rates of crashes, crashes with injuries, and crashes with fatalities were lower during the 6 months of March 1-August 31, 1974 following a decrease in speed limits to 55 mph (88 kph) on the Illinois Tollway, than the corresponding rates for any of the six preceding years, 1968-1973. During the same months of 1968-1974, rates of crashes and of crashes with injuries showed peaks without consistent trends, but rates and percentages of fatal crashes decreased. The data agree with the hypothesis that reducing speed limits on toll roads may lead to substantial reductions in rate of crashes and injuries.

by Theodore C. Doege; Paul S. Levy

Publ: American Journal of Epidemiology v103 n2 p236-41 (1976)

1976; 11refs

Presented, in part, at the Epidemiology Exchange of the Annual Meeting of the American Public Health Association, New Orleans, 23 Oct 1974.

Availability: See publication

HS-019 003

OPTIMIZING THE USE OF MATERIALS AND ENERGY IN TRANSPORTATION CONSTRUCTION. PROCEEDINGS OF A CONFERENCE CONDUCTED BY THE TRANSPORTATION RESEARCH BOARD, NOVEMBER 12-14, 1975

Four addresses precede 7 workshops which identified current practices that conserve energy and materials in construction, suggest innovative practices which might be tried in construction and materials technology and delineate research needs in the areas of binding agents, quality standards and quality control, aggregates and other materials, earthwork and existing roadway preparation, waste materials, by-products and recycled products, production and construction techniques and new products and procedure post-1985. The addresses stated that the energy crisis is real, serious and will continue to get worse. Optimizing use is the key to energy conservation. Energy implications can affect roadway decision making. Construction materials situation is discussed and places where materials may be in short supply are emphasized. One contractor's view of how energy and materials can be optimized is presented.

Participants in the workshops commented on information from the conference and the comments are included.

by Mildred Clark, ed.

Transportation Res. Board, National Res. Council, 2101 Constitution Ave., N.W., Washington, D.C. 20418

Rept. No. SR-166; 1976; 82p 40refs

Conference sponsored by the Federal Hwy. Administration, the Dept. of Transportation, the Federal Energy Administration, and the Energy Res. and Devel. Administration.

Availability: Corporate author, \$6.00

HS-019 004

SYSTEM CONCEPT STUDY FOR A CARGO DATA INTERCHANGE SYSTEM (CARDIS). FINAL REPORT

An analysis of functional and operational requirements of the Cargo Data Interchange System (CARDIS) is presented. From these requirements, system sizing estimates are derived. Three potential CARDIS concepts are introduced for consideration in subsequent analysis. Their characteristics are described and interface considerations with users and foreign systems developed. Functional flows of typical CARDIS transactions are presented with flow charts. The CARDIS alternatives are compared and a plan presented for CARDIS development. The study has shown several methods of CARDIS implementation all within current technological capability. A need for a flexible approach to CARDIS implementation is expressed, allowing the greatest variation in implementation and establishing access to essential user functions. The three alternatives examined (data transfer concept, unified data base concept, and the multiple CARDIS concept) are not rated or preselected in the present study. It is also concluded that CARDIS development will require attention to aspects of the international trading community.

by F. D'Alessandro; M. Wall

Computer Sciences Corp., 670 Winters Ave., Paramus, N.J. 07652

Contract DOT-TSC-851

Rept. No. DOT-TSC-OST-75-20; 1975; 95p 42refs

Rept. for Jul 1974-Jan 1975.

Availability: NTIS

HS-019 005

AVCR 1360-2 HIGH SPECIFIC OUTPUT-VARIABLE COMPRESSION RATIO DIESEL ENGINE

Development of the Teledyne Continental Motors' (TCM) AVCR 1360-2 variable compression ratio (VCR) diesel engine is reviewed. This is the culmination of fifteen years of VCR piston and high specific output research. The unique configuration and resulting performance of this 335 BMEP engine are presented. The special features of the engine design which were refined during the AVCR 1360-2 development phase include the VCR piston system, the X-pump fuel injection system, and the high pressure ratio induction system. Programs for development of satisfactory steady-state and transient performance and the design modifications necessary to reduce the peak transient smoke burst to acceptable levels include those dealing with induction and exhaust, fuel injection, acceleration, and smoke reduction. Pictures of the engine and parts are included. Diagrams of the cooling system, torque

December 31, 1977

HS-019 010

control system, induction and exhaust system are given. Graphs of performance characteristics are presented.

by J. R. Grundy; L. R. Kiley; E. A. Brevick
TELEDYNE Continental Motors
Rept. No. SAE-760051; 1976; 22p 4refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 006

THE PERKINS 6.247--THE HIGH SPEED, HIGH ECONOMY DIESEL ENGINE FOR NORTH AMERICAN LIGHT DUTY APPLICATIONS

The Perkins 6.247 diesel engine has been adapted specifically for the light-duty vehicle sector; the 6.247 engine design is discussed and its consideration as an alternative to the current predominant gasoline engines is justified. Differing emphasis in automotive technology has provoked interest in the use of diesel as opposed to gasoline engines, especially in this sector. Pictures of the engine and diagrams of its working parts are included. Environmental effects, gaseous emissions, smoke, odor, and noise of the engine are discussed. The diesel is better than the internal combustion engine in gaseous emissions and smoke generation, and worse than the IC engine in odor and noise production. The diesel is economically the more advantageous.

by D. E. Larkinson; R. J. Neal; W. J. Schultz
Perkins Engines Co.
Rept. No. SAE-760052; 1976; 16p 7refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 007

AUTO ELECTRONICS, THE CULTS BEGIN TO MESH

Current electronics application in the automobile industry is only a small percentage of the possible uses in this field. Two error-prone ingredients of engine operation, ignition and the air/fuel ratio, would be prime targets for electronics usage. An electronic spark timing (EST) microprocessor is being tested by General Motors (G.M.). Fuel monitoring system used by G.M. is an example of an electronic device now in use. RCA, Texas Instruments, and National Semiconductor have microprocessor systems for automobiles in various stages of development. Each would provide minimal memory capacity, but cost of the system remains a factor. A diagram of possible sensor requirements and a table of functions of present and prospective sensor suppliers are included.

by Carl A. Gottesman
Publ: Automotive Industries v154 n5 p17-21 (Mar 1976)
1976
Availability: See publication

HS-019 008

AN ASSESSMENT OF SEASONAL AND WEATHER EFFECTS ON THE FREQUENCY OF ROAD ACCIDENTS IN CALIFORNIA

The day-to-day variations in the number of accidents on the State Highways of California in 1970 have been studied with reference to the time of year and the weather type. The weather was found to be a major factor affecting accident numbers. The mean number per day was 353 and the overall variance 11158. The variance was reduced by over 70% when 23 wet days, Christmas Eve and Christmas Day were excluded. On very wet days the number of accidents was often double that of corresponding dry days. Single-vehicle accidents were affected more by wet weather than were most other types of accidents studied.

by S. P. Satterthwaite
Publ: Accident Analysis and Prevention v8 n2 p87-96 (Jun 1976)
1976; 9refs
Availability: See publication

HS-019 009

DETECTION DISTANCE IN DAYLIGHT OF ROOF-MOUNTED EMERGENCY VEHICLE LIGHTS

The distance threshold for visibility in daylight was determined for four flashing incandescent signal systems and for two types of gas discharge tube arrays. The test condition was red signals viewed in clear daylight, and the parameter tested was distance from viewer in miles at the absolute threshold of visibility for each type of light. The distance threshold was found to be a function of the physical construction of lamp housings and the flash pattern as well as of effective intensity. Certain combinations of internal reflections, glare, and complex flash patterns were found to reduce the overall distance threshold. Rotating sealed beams seem to be preferable, especially when modified to reduce internal reflections and diffused skylight glare in daylight. Gas discharge tube systems gave relatively poor performances. Tabulations are given of the physical and photometric characteristics of the lights studied.

by Wayne Muhler; Jan Berkhout
Grant DOT-OS-50121
Publ: Journal of Safety Research v8 n2 p50-8 (Jun 1976)
1976; 13refs
Availability: See publication

HS-019 010

USING PHOTOGRAPHS TO MAP TRAFFIC ACCIDENT SCENES: A MATHEMATICAL TECHNIQUE

A mapping technique that is based on the mathematical relationship between points in one plane, such as a roadway surface, and the projection of those points in another plane, namely a film image of that roadway surface is described. The technique can be applied to any photograph, providing four calibration points can be identified and measured on both the roadway and the film image of that roadway. During traffic-accident investigations various measurements are usually made of the accident site. Such measurements are often incomplete, however, thereby complicating accident reconstruction efforts.

from the shoulder of the roadway, selecting position or calibration points far apart, taking a series of pictures when roadway features to be photographed extend over substantial lengths of roadway and adjusting for nonflat roadway surfaces.

by Robert L. Bleyl

Publ: Journal of Safety Research v8 n2 p59-64 (Jun 1976)

1976; 4refs

Availability: See publication

HS-019 011

ALCOHOL AND OTHER DRUGS RELATED TO YOUNG DRIVERS' TRAFFIC ACCIDENT INVOLVEMENT

Patterns of driving, drinking, and drug-taking among young people and assessments hypotheses linking these behaviors to collision involvement are made. The implications for social policy of current knowledge about these problems are discussed in terms of approaches that stress primary prevention. Specific recommendations are offered for legal changes to reduce the incidence of alcohol- and drug-related damage among young people, including the following: reducing availability of alcohol and other drugs; lowering the Blood Alcohol Concentration Level to 0.04%; raising the drinking age, at least to age 19; and increase of unfavorable consequences of impaired driving among young drivers.

by Paul C. Whitehead; Roberta G. Ferrence

Publ: Journal of Safety Research v8 n2 p65-72 (Jun 1976)

1976; 43refs

Revised version of a paper presented at the 7th Annual Conference of the Canadian Safety Council, Vancouver, Oct 1975.

Availability: See publication

HS-019 012

CYCLING IN THE DARK: AN ANALYSIS OF FATAL BICYCLE ACCIDENTS IN THE NETHERLANDS

Statistical data on the proportions of daytime and dusk/nighttime cycling in urban and rural areas and the respective proportions of accidents are presented. Survey data show that the average percentage of encounters between cyclists and travelling motor vehicles throughout the year is 92% during the day and 8% at night. The percentages of fatal accidents, however, are 75% during the day and 25% at night. The risk of having a fatal collision is thus nearly 4 times greater under conditions of darkness. In addition, the risk of fatal impact was shown to be particularly great for head-tail collisions in rural areas at night. This may be related to perceptibility of the rear of the bicycle. Measures such as more reliable rear lights or large red retroreflectors on bicycles might help to alleviate this problem.

by P. C. Noordzij

Publ: Journal of Safety Research v8 n2 p73-6 (Jun 1976)

1976

Availability: See publication

TRAVELLED. PT 2

Variables affecting road accidents in Queensland 1963-64 are evaluated. The variables treated are occupancy, area of vehicle use, hour and day of accident. Car-class vehicles including station wagons and taxis are considered. The major finding is that the risk of involvement owing to factors other than the size of traffic increases gradually and steadily from about 6 am in the morning through the day to the late night hours. It is believed that this finding may bring a new perspective and direction of thinking into the pragmatic study of road accidents. Research could give answers to the whys and hows of this finding. Concerning the day-of-week variation of the casualty involvement rates according to various levels of occupancy, a fairly regular pattern evolves: rates increase consistently throughout the workdays to their peak on Saturdays, and thereafter, for Sundays, they drop back to a lower-risk level. The four-level occupancy deviates somewhat from this pattern by exhibiting its largest rate on Fridays, but no special reason than that of chance variation can be given. The risk-pattern for noncasualty accident involvements is much more regular. Solo occupancy has the largest rate throughout the week, and the rates decrease as the occupancy increases (with some minor irregularities) on every day of the week. An irregularity is caused by three-occupant level, where the otherwise even decrease slows down somewhat, and a minor ridge appears on the graph. Level of occupancy is an important factor and needs to be studied further. Considering the various seats separately it was found that the rate increases from the right to the left in both the front and rear seats. The different types of accidents contribute very differently to this development. With respect to collisions between motor vehicles, among the front seats that of the driver's produces the least number of casualties for the same distance of travel. Other evidence shows however, that his injuries when sustained are comparatively more severe. Otherwise the rank-order of the rates for collisions between motor vehicles taken separately is similar to that described for all accident involvements above. The rate increases from right to left in each the front, and the rear compartment. With respect to single car accidents, the driver is in the most vulnerable position, closely followed by the front left-seat passenger for equal distance of travel.

by L. A. Foldvary

Publ: Accident Analysis and Prevention v8 n2 p97-127 (Jun 1976)

1976; 2refs

Part 2 of a series reporting on the 1963-64 Queensland, Australia vehicle-mile performance survey. Part 1 was published by Foldvary in 1975. Pt. 1 is HS-017 331.

Availability: See publication

HS-019 014

THE TRAFFIC BEHAVIOUR OF ELDERLY MALE AUTOMOBILE DRIVERS IN GOTHENBURG, SWEDEN

Traffic behavior of elderly male automobile drivers was surveyed with accompanying statistics. 406 drivers over 60 years of age with automobile driving licenses issued in Gothenburg, Sweden, were asked by questionnaire about their driving habits in 1971. A comparison group of 126 drivers around 40 years of age was also surveyed. A large proportion of the older drivers declared that they no longer drove their cars.

given up driving voluntarily because of age and illness. Self-selection seems to be one of several factors of importance when judging traffic safety risks of elderly drivers. The annual distance driven by the older driver groups was shorter than in the younger age group. Older drivers used their cars for other purposes than younger drivers, and they also avoided driving in darkness, on icy roads, and in unknown cities to a greater extent than younger drivers. The total number of accidents and offenses during the older drivers' whole life span as drivers was lower than the corresponding figures in the younger age group. It is concluded that these differences may depend on the shorter annual distance driven by the older drivers, the change in traffic density in the investigation area, and also on the older drivers' awareness of their reduced capacity. Their accident and offense rate during a three year period is similar to the rate in the comparison group.

by Lars Ysander; Birger Herner

Publ: Accident Analysis and Prevention v8 n2 p81-6 (Jun 1976)

1976; 23refs

Availability: See publication

HS-019 015

MOTOR VEHICLE SAFETY INSPECTION TRAINING AND REFERENCE MANUAL. CARS AND LIGHT TRUCKS. BOOK 1, BRAKES, STEERING AND SUSPENSION, WHEELS AND TIRES

A training and reference manual for motor vehicle safety inspection of brakes, steering and suspension systems, wheels, and tires of cars and light trucks is presented. Inspection procedures and inspection equipment described conform closely to safety inspection standards developed by the Motor Vehicle Manufacturers Association of the United States, Inc., the American National Standards Institute, Inc., and the U.S. Department of Transportation. Each topic is discussed in terms of theory and description of operational systems and in terms of proceduralized inspection and testing, describing general instructions, safety precautions, and special tools and equipment needed in each category. Brake system topics include: hydraulic, drum, and power brake principles and operational characteristics; effects of other vehicle components on brake system safety; brake system failure indicator, leakage, pedal reserve, power brake booster pedal drop, and service brake performance tests; brake hose, lines, and drum, disc condition, friction material condition, component structural and mechanical condition, and power vacuum booster and line inspection. Steering and suspension topics include: manual steering gear design; power steering systems; steering linkage design; springs and torsion bars; front suspension design; front suspension and steering alignment; rear suspension design; hydraulic shock absorbers; how other vehicular components affect steering and suspension safety; tests for steering system lash, freeplay, linkage play, steering movement, wheel alignment/toe angle, and shock absorber operation; inspection of power steering, front and rear suspensions, and shock absorber (for leakage). Wheels and tires topics include: design features; construction methods; sidewall data; special purpose tires; tire and rim matching; tire mixing; abnormal tire wear patterns; tread depth inspection; tire size and type comparison; tire condition, tire damage, and wheel integrity, deformation, and mounting inspection. Integrated, proceduralized vehicle inspection instructions are given for testing and inspecting all these components. Learning aids for identifying

provided. Public relations aspects of the inspector's job are also discussed.

Chek-Chart, P.O. Box 6227, San Jose, Calif. 95150

1975; 83p

Availability: Corporate author

HS-019 016

MOTOR VEHICLE SAFETY INSPECTION TRAINING AND REFERENCE MANUAL. CARS AND LIGHT TRUCKS. BOOK 2, LIGHTING AND ELECTRICAL SYSTEM, VEHICLE GLAZING, BODY AND SHEET METAL, EXHAUST AND FUEL SYSTEM

A training and reference manual for motor vehicle safety inspection of the lighting and electrical system, vehicle glazing, body and sheet metal, and exhaust and fuel systems of cars and light trucks is presented. Inspection procedures and equipment described conform closely to safety inspection standards developed by the Motor Vehicle Manufacturers Association of the United States, Inc., the American National Standards Institute Inc., and the U.S. Department of Transportation. Each topic is discussed in terms of theory and description of operational systems and in terms of proceduralized inspection and testing, describing general instructions, safety precautions, and special tools and equipment needed in each category. Lighting and electrical system topics include: automotive electrical systems; headlamp, taillamp, license plate lamp, parking lamp, stop lamp, turn signal, hazard warning lamp, backup lamp, clearance and side marker lamps, horn, and accessory lighting circuits; reflex reflectors; starting switches; headlamp aiming and inspection devices; lamp and reflector inspection for condition and operation; horn and electrical system inspection; starting safety switch test; headlamp aim inspection mechanical, photoelectric, and screen methods; and fog lamp aim inspection. Vehicle glazing topics covered are: safety glass standard characteristics, certification, and marking of safety glazing materials; shade b and tinting; defects and damage; glazing markings, condition, stickers, and tinting inspection; and window operation test. Body and sheet-metal topics include: body and sheet-metal integrity; rearview mirrors; windshield wipers, washers, and defroster; sun visors; seats and seatbelts; and inspection of rearview mirrors, windshield apparatus, sun visors, seats and seatbelts, floor pan, exterior body, doors, hood, and trunk. Exhaust and fuel-system topics include: systems descriptions and systems condition inspections both underhood and under-vehicle. Learning aids for identifying and inspecting components and component characteristics, glossary, index, and sample vehicle inspection check sheet are also provided.

Chek-Chart, P.O. Box 6227, San Jose, Calif. 95150

1975; 43p

Availability: Corporate author

HS-019 017

EMISSIONS, FUEL ECONOMY, AND DURABILITY OF LEAN BURN SYSTEMS

Several makes and models of cars were modified for lean-burn operation using the Turbulent Flow Manifold (TFM), a unique intake manifold that provides improved preparation and dis-

presented for the various cars modified for testing. Exhaust port liners and thermal reactors were shown to be effective devices for reducing emissions from the basic lean-burn system. One car equipped with the TFM, port liners, and reactors was operated for 50,000 miles on an EPA-type durability test and had emissions well below the 1975 standards for California. Emissions, fuel economy, and durability data are presented in tabular form. Appendices detail the V-8 turbulent flow system, the system with exhaust port liners, test procedures and turbulent flow system for European engine, and durability car.

by W. E. Adams; F. J. Marsee; R. M. Olree; J. C. Hamilton
Ethyl Corp. Res. Labs., Detroit, Mich.
Rept. No. SAE-760227; 1976; 37p 22refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 018

CORROSION TESTING OF CHROMIUM PLATED ALUMINUM BUMPER BAR STOCK

The behavior of Cu-Ni-Cr plated aluminum bumper bar stock of Alloy X7046 in a number of accelerated and atmospheric corrosion tests is described. Three different pre-plate procedures with several combinations of Cu-Ni-Cr were tested. The preferred combinations of pre-plate and top coating showed results equal to steel plated bumpers of commercial quality. It is concluded that the pretreatment used before applying the top coatings is important in its effect on corrosion behavior. A difference between Alstan pretreated parts and those processed through zincate solutions is demonstrated, with the Alstan pretreatment preferred because of the absence of lateral corrosion at the interface between substrate and coating which is associated with the Alstan process.

by J. C. Jongkind
M & T Chemicals, Inc.
Rept. No. SAE-760228; 1976; 11p 2refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 019

THE UTILIZATION OF PLASMA-DEPOSITED COATINGS ON ALUMINUM

A description of the plasma coating process, the microstructure of the coatings, properties of coatings, and some design considerations in using the coatings on aluminum are presented. Utilization of plasma-deposited coatings on aluminum has resulted in advantages of high strength-to-weight ratio, good thermal and electrical conductivity, and good corrosion resistance. Poor wear and friction characteristics and low melting points are detrimental aspects of their use. It is established that plasma deposited ceramic, cermet, and metallic coatings on aluminum substrates offer all the advantages of aluminum components with additional benefits of surfaces which can be tailored to meet unique wear, frictional, thermal, or other requirements in a particular application. The successful utilization of the plasma-deposited coatings is shown to depend on understanding mechanical properties of the coatings

tions or deposition. A discussion of these points is followed by several examples of the use of such coatings on aluminum alloys in the automotive industry.

by R. C. Tucker, Jr.
Union Carbide Corp., Linde Div.
Rept. No. SAE-760230; 1976; 12p 4refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 020

LONG RANGE ALUMINUM AVAILABILITY

A study was made of U.S. and worldwide aluminum supply and demand and of the issues which led to shortages experienced in the recent past. Key economic factors and the impact on future availability of aluminum are discussed by constructing possible cause-and-effect scenarios. External factors which influence the availability of aluminum include demand, worldwide economic boom, hydroenergy shortage, price controls, and excessive exports. Another basic factor is the availability and cost of mining and processing bauxite, from which alumina and aluminum are made. Relative power costs and savings in operation of aluminum smelters and applications are also studied with relation to supply and demand. It is concluded that long-range aluminum availability can be capacity limited, exerting strong pressures on price. Balance of trade among nations is also a limiting factor on availability and price range.

by Yeshwant O. Telang
Ford Motor Co.
Rept. No. SAE-760231; 1976; 8p 3refs
Paper presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 021

THE VIN (VEHICLE IDENTIFICATION NUMBER) IN STATE VEHICLE REGISTRATION AND RECORDS

The use of VIN (vehicle identification number) in state vehicle registration and records is examined. It is suggested that standardization of the VIN format would facilitate the extensive governmental and commercial uses of VINs and VIN-related information, enabling effective service to the motoring public and to the variety of other public and private interests seeking access to information contained in a motor vehicle agency's record-keeping system. Standardization features suggested include accurate means by which VINs can be entered into the agency's record-keeping system and a format for VINs to more completely describe a particular vehicle. The use of VINs by the motor vehicle agency, police agencies, district courts and traffic courts, lawyers, money-lending institutions, tax agencies, insurance companies, research organizations, vehicle data publishers, and recall users is described in detail. The volume and kind of needs displayed emphasize the need for a standardized format for the VIN which would be less susceptible to clerical error in transcription, easily verifiable

by George O. Stevens
Michigan Dept. of State
Rept. No. SAE-760232; 1976; 7p
Paper presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 022

THE VIN (VEHICLE IDENTIFICATION NUMBER) IN VEHICLE SECURITY AND THEFT RECOVERY

The use of the vehicle identification number (VIN) in combating automobile theft is described. It is pointed out that with automobile theft approaching 1,000,000 annually in the United States, automobile manufacturers are increasingly aware of the importance of the VIN in recovery attempts. Even though commercial auto thieves use increasingly sophisticated techniques to falsify VINs on stolen vehicles, voluntary and required procedures are currently being employed by manufacturers to counter these actions. Secondary and confidential markings can now provide the law enforcement agent with another means to make positive identification of a suspected stolen vehicle. Since the VIN is still the only legal identification accepted in the courts to prove rightful ownership of a motor vehicle in the United States, increasing realization of its limitations and capabilities is noted.

by Robert F. Campbell
National Automobile Theft Bureau
Rept. No. SAE-760233; 1976; 6p
Paper presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 023

THE VIN (VEHICLE IDENTIFICATION NUMBER) IN INDUSTRY AND ITS INTERNATIONAL APPLICATION

The use of the vehicle identification number (VIN) in industry and its international application is discussed. Recognition is given to the problem of maintaining records of more than 275 million vehicles presently registered throughout the world. Monitoring the life of a given vehicle from its fabrication to its destruction can best be accomplished by the interface of major computer programs and a uniform system for vehicle identification. As the VIN is the legal identification for each vehicle, every manufacturer has the responsibility of assigning a unique VIN to each vehicle, in compliance with numerous procedures, standards, and laws. The VIN is attached to the vehicle, stamped and embossed on components, and printed on tamper resistant labels. It is printed on hundreds of documents and maintained in numerous files. The identification of vehicles is of international concern and the International Standards Organization (ISO) has recently approved standards dealing with content, structure, and display of a uniform worldwide vehicle identification numbering system. The ISO

by D. R. Wolfslayer
Chrysler Corp.
Rept. No. SAE-760234; 1976; 14p
Paper presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 024

SILICONE ELASTOMERS FOR AUTOMOTIVE ELECTRONIC APPLICATIONS

An overview of the field of silicone elastomers is presented, starting from the types of cure systems now available and ending with specific applications. Silicone elastomers are characterized by electrical and physical stability over a wide temperature range, a wide selection of viscosities which facilitates mixing and dispensing operations where rheology is significant, a wide range of curing schedules, cured hardnesses from a gelatinous material to a 90 Shore A durometer rubber, and protective capabilities for electronic components and circuitry from moisture, dirt, vibration, thermal shock, mechanical handling and abuse, and electrical failure. Automotive electronics applications are cited in the continuing development of packaging reliability. Factors in selection of the best elastomer for a particular application are discussed, with cure systems forming natural groups for selection purposes. Applications are discussed, and four special platinum catalyzed products are highlighted: dielectric gels, platinum catalyzed silicone rtv foams, one and two-part heat sink encapsulants, and high-purity materials.

by Daryl D. Dickson, Jr.
Dow Corning Corp.
Rept. No. SAE-760235; 1976; 10p 3refs
Paper presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 025

POLYURETHANES: A DIFFERENT BREED OF ELECTRICAL AND ELECTRONIC INSULATING MATERIALS

Polyurethane electrical and electronic insulating materials are described in application in the automotive industry. New developments in aliphatic diisocyanate technology are producing polyurethane casting and potting elastomers that are competitive with epoxies and silicones for dielectric insulation of electrical and electronic solid state systems. The history of development of the polyurethanes is reviewed in aspects of chemistry, applications, and restrictions. Hazards such as moisture sensitivity and respiratory effects of polyurethane materials in their liquid states are also discussed. Favorable advantages of the polyurethanes for use in automotive applications include good dielectric insulating characteristics, chemical resistance, easy handling, and relative low cost. New technology in flame retardancy is being pursued to accomplish better passenger safety in the automotive environment. It is predicted

HS-019 026

that the use of polyurethanes in electronic systems will increase in relation to technological development and demand.

by Thomas S. Simon, Jr.
Dexter Corp., Hysol Div.
Rept. No. SAE-760236; 1976; 7p 3refs
Paper presented at Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 026

SHOCK RESISTANT EPOXIES FOR USE AT HIGHER UNDER-THE-HOOD TEMPERATURES

Methods currently used to improve the shock resistance of heat resistant epoxy adhesives and insulation compounds include the addition of asbestos, glass fibers, and other fillers; the incorporation of polyurethanes, nitrile rubbers, and other elastomers; and the use of chain extending latent curing agents. New experimental data are also presented for a series of flexible, anhydride-cured, epoxy insulation compounds showing that it is now possible to combine improved shock resistance with long term thermal and hydrolytic stability by proper selection of the polyester flexibilizer and by avoiding the strongly basic amine accelerators used in the past. The results also indicate that many presently used flexible epoxy-anhydride insulation compounds may be subject to hydrolytic failure, suggesting the need to include a reversion test as part of the selection procedure for new insulation materials.

by Justin C. Bolger
Amicon Corp.
Rept. No. SAE-760237; 1976; 11p 19refs
Paper presented at Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE
1976; 12p 3refs
Paper presented at Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 028

THE CERAMIC GAS TURBINE--A CANDIDATE POWERPLANT FOR THE MIDDLE- AND LONG-TERM FUTURE

The ceramic gas turbine engine is examined for its potential applications against a background of problems of energy availability in the middle- and long-term future, environmental pollution, and materials availability. The ceramic gas turbine is shown to have potential as an advantageous candidate powerplant for both the middle- and long-term future. The Ford ceramic gas turbine program is described as a systems development program encompassing all aspects of turbine ceramics technology, including design, materials, fabrication processes, testing, and evaluation. The ceramic gas turbine features multi-fuel capability, high thermal efficiency, lowest emissions potential, use of abundant and nonstrategic materials, and lightweight and small volume package for given horsepower levels. New technology for applying brittle materials to structural engineering applications is discussed.

by A. F. McLean; D. A. Davis
Ford Motor Co.
Rept. No. SAE-760239; 1976; 20p 37refs
Presented at Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HSL 76-

HS-019 029

DEVELOPMENT OF A CERAMIC BLADE-SUPERALLOY DISK ATTACHMENT FOR GAS TURBINE ROTORS

A unique ceramic blade/metal disk attachment scheme has been developed for application to gas turbine engine rotors. Design, fabrication, and testing of single blade attachments at room temperature have been completed. Having established a statistical mean and 99.5% lower bound ultimate strength levels, three single blade attachments have been tested at 100% of the lower bound design point for demonstration of attachment capabilities. Only the characterization of the elevated temperature properties and the establishment of the design limits remain to demonstrate the full capabilities of the attachment concept by spin testing a fully bladed hybrid rotor at elevated temperatures. Development of a new technique for attaching hot pressed silicon nitride ceramic airfoil shapes to wrought AF2-1DA superalloy disk using the GATORIZING isothermal forging process is described. Subsequent elevated temperature attachment development techniques for establishing design criteria for operation in the gas turbine environment are also defined.

by Bryant H. Walker; William D. Carruthers
Pratt & Whitney Aircraft
Rept. No. SAE-760240; 1976; 8p
Presented at Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 030

OPTIMUM DESIGN OF A CERAMIC TURBINE WHEEL

Optimum turbine wheel geometry for passenger car gas turbine engines has been calculated for two ceramic materials: hot pressed silicon nitride and densified silicon carbide. Two iterative strategies, coupling the mathematical programming techniques with methods of fine elements and finite differences, were used for finding the disk with minimum failure probability. The influences of mean strength, Weibull modulus, and the disk form on the failure probability are presented. Results show that an improvement in material quality is necessary if the ceramic gas turbine wheel is to become a dependable component. The optimization methods which were used for calculation of disk contours can be applied to any other problem when a reasonable mathematical model is constructible, giving results efficiently and enabling evaluation of the sensitivity of the objective function to the change of design parameters.

by J. Tomas
Volkswagenwerk AG, Germany
Rept. No. SAE-760241; 1976; 8p 8refs
Presented at Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 031

THE ELECTRONIC CONTROL UNIT FOR PRODUCTION ELECTRONIC FUEL INJECTION SYSTEMS

A functional description of the 1975 production electronic fuel injection system is presented, relating system performance to automobile performance requirements. Emphasis is placed on the architecture and physical design of the heart of the system, the electronic control unit (ECU). Accuracy requirements and environmental and durability constraints imposed on ECU design are discussed. The extensive on-line testing that is performed to ensure necessary levels of accuracy on a cost-effective basis and at through-put rates consistent with automotive production scheduling is shown to present a major manufacturing challenge. Design modifications expected to result from present and anticipated technological advances are overviewed. Anticipated design changes include greater calibration flexibility with fewer circuitry components and more compactness. It is predicted that the current hybrid analog design will be replaced by a design based on digital metal-oxide-semiconductor technology. New types of digital circuits are also being evaluated for use in such systems.

by J. G. Rivard
Bendix Electronics and Engine Control Systems Group
Rept. No. SAE-760242; 1976; 10p 7refs
Presented at Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 032

AUTOMATIC COMPUTER-CONTROLLED CALIBRATION OF EFI (ELECTRONIC FUEL INJECTION) CONTROL UNITS

Calibration testing of the electronic control unit (ECU), an analog computer which controls injector operation in the recently introduced domestic passenger car electronic fuel injection system, has been accomplished at a series of test stations. The stations were equipped with specially designed, computer-controlled automatic test equipment (ATE). The overall test sequence to which an ECU is subjected following manufacture is outlined, describing in detail the design logic, hardware, and software associated with the two ATE systems used. Particular emphasis is given to the Trim Station ATE, which performs complete functional testing and also computes optimum values for 28 resistors incorporated into the circuit at this stage to optimize circuit performance. These values are transmitted to the laser trimmer, which cuts individualized resistance modules for each ECU. After module insertion, the ECU is retested, packaged, and final tested. The identical second test station and final test station ATE systems are electronically similar to the Trim ATE but have no resistance-optimizing capability and are fixtured to accommodate up to 10 units at a time. Reliability in the test systems is demonstrated.

by J. H. Schlag
Systems Instruments Res., Inc.
Rept. No. SAE-760243; 1976; 12p 4refs
Presented at Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 033

THE EFI-CONTROL-UNIT FINAL TEST STATION (ELECTRONIC FUEL INJECTION)

The development of one part of the overall test facility for evaluating levels of performance, throughput, reliability, and maintainability for the electronic control unit (ECU) used in the Bendix electronic fuel injection (EFI) system is described. The test station accepts control units at several stages of production completion and applies to them simulated manifold-vacuum pressures in a computer-directed sequence. The 100-torr (13-kilopascal) pressure steps propagate pressure surges of less than 0.2 torr (26 pascals) back to the source tanks, and total system settling time is 0.6 second or less. The station is both reliable and easily maintainable, being human engineered for efficient manual loading and unloading of test units. The final test station has reduced per unit test time by more than 50% and has increased shift production of ECUs to levels that permit meeting of passenger car production requirements. In design of the final test station three major objectives were met: minimizing the settling time, utilizing the computer to implement essentially simultaneous testing of five control units at each pressure step, and timesharing the loading, unloading, and housekeeping activities of a single station operator between units under test and units to be loaded or unloaded. Results of the development effort were to increase production throughput to the point that up to 500 ECUs could be processed each day and to decrease the test labor cost per unit.

by C. J. Ahern; J. H. Tarter; W. G. Wolber; G. T. Bata
Bendix Res. Labs.; Bendix Electronics and Engine Control Systems Group
Rept. No. SAE-760244; 1976; 12p 4refs
Presented at Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 034

A PRECISION PRESSURE-SOURCE SYSTEM FOR EFI (ELECTRONIC FUEL INJECTION)-CONTROL-UNIT CALIBRATION AND TEST

Development of a precision pressure-source system for electronic fuel injection (EFI) electronic control unit (ECU) calibration and test is described. The objective of development was to simulate manifold absolute pressure for calibration and testing of domestic EFI controls, demanding an absolute-pressure-source-system stability, accuracy, and speed of response not previously required for automotive component manufacturing. A 36 point pressure source having a root-mean-square stability of plus or minus 0.002 pound per square inch absolute, an accuracy of better than plus or minus 0.002 pound per square inch absolute, and a response time of 500 milliseconds into a 1-cubic-inch switched volume was developed to meet this need. Source-system design drew heavily on aircraft flight-line-check-out test equipment experience. The system is used for 100% production calibration and test of EFI ECU's. It is concluded that although present system performance is adequate and continuous-service system reliability is better than had been anticipated, frequent pressure calibrations are essential to the maintenance of absolute accuracy. A

Kudlaty
Bendix Corp.
Rept. No. SAE-760245; 1976; 11p 4refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 035

AN ON-LINE PRESSURE MONITOR FOR EFI- CONTROL-UNIT TEST DIAGNOSTICS (ELECTRONIC FUEL INJECTION)

An on-line pressure monitoring system, designed to meet the need for constant accuracy surveillance on the precision pressures that are applied to electronic fuel injection (EFI) electronic control units (ECU) during production calibration and testing, is described. Design requirements and approach to the sensor are discussed, and system implementation and performance are detailed. The approach required that design, construction, and check-out times be minimized, and that components selected be readily available. A modular design was adopted, utilizing individual pressure transducers on each tank and parallel signal processing for the threshold alarm signal, followed by a multiplex arrangement at the strip-chart recorder for sequential scan recording and single-channel deviation monitoring. The system concept to which these basic decisions led is illustrated schematically and its operation described. The pressure monitor, which operates in both a scan and a set mode, detects and measures pressure deviations in up to 39 precision pressure sources, and activates an alarm to alert test personnel should an out-of-tolerance condition develop. The monitoring system has significantly reduced the incidence of test operator error, and has played a major role in substantially increasing production yields.

by A. E. Young; D. H. Locher; W. G. Wolber
Bendix Corp.
Rept. No. SAE-760246; 1976; 10p 2refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 036

AUTOMATIC TESTING OF PRESSURE TRANSDUCERS FOR FUEL INJECTION SYSTEMS

The recent introduction of electronic fuel injection as standard equipment on a domestic passenger car created the need to evaluate the increased production of several hundred pressure transducers per shift. The development of a test system able to evaluate these large number in a batch mode, with minimal operator interaction is described. Production/evaluation has reached 200 units within 3.5 to 4 hours. The testing system determines zero-set, slope, linearity, and temperature coefficient, and, at the end of each 200 unit run, prints out the raw data, presents data in the form of a histogram, and annotates all out-of-tolerance conditions. A prediction of even greater testing capacity is made dependent on increased computer

Servonic/Instrumentation Div., Gulton Industries, Inc.
Rept. No. SAE-760247; 1976; 10p 1ref
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 037

RESEARCH STUDY ON CONSEQUENCES OF VIBRATION ACTING ON OCCUPANTS OF MOVING VEHICLES (STUDIO DI RICERCA SULLE CONSEGUENZE DELLE VIBRAZIONI SULLE PERSONE OCCUPANTI VEICOLI IN CIRCOLAZIONE)

Investigations were made of the psychophysiological sequences of low-frequency sound and mechanical vibration acting on occupants of moving vehicles, with particular concern for designing methodology and instrumentation reproducible, measurable results. The Fiat coupe model was chosen for testing as representing the most modern situation technically acceptable for a four-door, four-seat car with front-mounted engine and front-wheel drive. Three situations were analyzed with transducer vibration detection equipment connected to measurement and registration instruments mounted on the test car: moving on road (2-500 Hz frequency vibrations) stationary with engine idling, and stationary on bench. Psychophysiological effects include fatigue, annoyance, visual degradation (including legibility), aural degradation, psychomotor degradation (in tracking tasks), discomfort, reduced aptitude for cognition and reaction, nausea, euphoria, hyperventilation, hypocapnia, muscle tensing, neuromuscular states, microtraumas of vertebrae and tendinous structures, vasodilatation, vasoconstriction, extrasystoles, and changes in heart rate, cardiac index, and arterial pressure. Vibrational effects depend essentially on relative shifts to which individual organs and individual portions of body tissues are subjected through stress and transmission of stress and through induction of altered kinesthetic states. Intrinsic and extrinsic factors which govern the applied stress include: body shape; stature; weight; posture; muscular activity; direction/position/area of application; vibration intensity; distribution/mass/dynamic properties of clothing or links on the person; and dynamic characteristics of structures between vibration source and the person (such as seat cushions). These effects can sometimes be correlated with either intensity or frequency of vibrations, but have not usually been considered as a function of duration. The evaluation of optimum tolerability and affective limits of effects of vibrations on humans was carried out considering factors of intensity, frequency, and duration. Degradation noted for hearing and word comprehension between 2 and 20 cycles per second (cps); for psychomotor ability in task performance between 1 and 27 cps especially at long range between 10 and 20 cps especially at short range; and for visual performance between 10 and 23 cps. The ISO guide exposure limits are subject to criticism in three aspects: limits recommended for vertical vibrations relevant to comfort and efficiency in task performance seem too high; laboratory-determined limits seem inapplicable to field situations due to high tolerance in test situations; and dependence of limits suggested on duration is not documented except by unreliable extrapolation from data in literature. In particular, the lack of uniformity in experimental approaches used precludes gathering

valid limits. Results of this study are not generalizable as yet. Recommendations are made for a complete statistical investigation including other fields of frequency and quantified measurement of human factors and effects. Tables by make and model are given for factory new domestic and foreign car registrations in Italy in 1972.

by F. Moscarini
Istituto Sperimentale Auto e Motori, S.p.A., Italy
Rept. No. LS-55477; 1975; 161p 42refs
Agreement between the Ministry of Transportation and the Experimental Auto and Engine Inst., Inc. Rept. on Italian Safe Vehicle Prog. Rept. for 27 May 1974-25 Jul 1975.
Supplementary to "Guide for the Evaluation of Human Exposure to Whole Body Vibration" (International Organization for Standardization, 1972).
Availability: Reference copy only

HS-019 039

SCHOOL TRIP SAFETY AND URBAN PLAY AREAS. VOL. 1: EXECUTIVE SUMMARY. FINAL REPORT

by Martin L. Reiss
BioTechnology, Inc., 3027 Rosemary Lane, Falls Church, Va. 22042
Contract DOT-FH-11-8126
Rept. No. FHWA-RD-75-104; 1975; 13p
For abstracts, see Vols. 2-7, HS-019 040--HS-019 045.
Availability: NTIS

HS-019 040

SCHOOL TRIP SAFETY AND URBAN PLAY AREAS. VOL. 2: STUDENT AND DRIVER PERCEPTION OF SCHOOL TRIP SAFETY AND TRAFFIC CONTROL DEVICES. FINAL REPORT

Guidelines for the protection of young pedestrians (ages 5 years to 14 years) walking to and from school were developed, based on field surveys to the young pedestrian and the driver regarding designated school zones and specific school crossing protective devices. Three sources of data were utilized to define problems and to develop the guidelines for related safety programs, including literature review including accident data, young pedestrian knowledge and stated behavior from field study, and driver knowledge and observed behavior from field study. Accident data were primarily urban and were used to determine the magnitude of young pedestrian school trip accidents and specific ages of pedestrians involved. The student survey identified student knowledge and behaviors which need modification and designated procedures for modification of those knowledges and behaviors. Driver surveys identified driver perceptions and motivational factors, identified driver reaction to school zone environment, and correlated responses with actual behavior. Procedural techniques for data gathering are described. Findings show that the youngest students (5-8 years) are overinvolved in school walking trip accidents, while older students (10-14 years) are underinvolved in similar accidents. There is a decreasing likelihood of school trip accident involvement as pedestrian age increases from 5 to 14 years. Significantly more younger students than older students indicated their unawareness or nondiscrimination between various traffic control devices. Students considered uniformed crossing guards safer than other traffic control devices and indicated they would vary their route to school on the basis of

drivers who drove past the signs used in the test one or more times a week did see the signs, but did not correctly identify the signs that were present. Although most drivers were aware of the school zone and of posted speed limits, 85% of drivers exceeded the legal speed limit by an overall mean speed of 10 mph. A significant reduction in speed was observed when flashing signals were used in conjunction with a school not visible to the driver from the location of the signal. Based upon these findings, it is recommended that local and state school safety programs be developed for both drivers and students, that a safe walking route to school map be incorporated into the program, that the program should be maintained and periodically evaluated as part of a continuing effort over a widespread area.

by Martin L. Reiss
BioTechnology, Inc., 3027 Rosemary Lane, Falls Church, Va. 22042
Contract DOT-FH-11-8126
Rept. No. FHWA-RD-75-105; 1975; 189p 77refs
Work unit No. FCP-31E2032.
Availability: NTIS

HS-019 041

SCHOOL TRIP SAFETY AND URBAN PLAY AREAS. VOL. 3: A SURVEY OF THE CHARACTERISTICS OF THE URBAN PLAY STREET. FINAL REPORT

A survey of the characteristics of the supervised urban play street was conducted by gathering data relating to existing New York City play streets. The method of the survey was a combination of observation and identification of play street practices and an evaluation of these practices to form recommendations. After observation of New York and Philadelphia play streets, discussions were held with traffic engineers, police authorities, Police Athletic League (PAL), and the Mayor's office. The observation and discussion information provided an informed basis for conducting play street surveys on 20 streets contacting 200 users and 200 residents and merchants (adults), making 500 street characteristics observations, and interviewing 86 PAL street workers. These data on practices allowed an evaluation of the practices in order to identify best existing practices and to suggest improvements. The evaluative result was incorporated in development of a play street guide book. Survey forms used in the survey are illustrated. Information areas include street and area descriptors, observations of street use, observations of vehicle intrusions on the play street, play-street user demographics, and play-street resident and merchant reactions. The advantages of a play street are pointed out: economy (no construction is required to create the urban play area using the street); accident reduction potential; and a number of social, educational, and recreational benefits at a comparatively low cost. Acceptability of the play street is indicated by survey results among users and residents on the street. Tables included provide information concerning play street status in various cities, Police Athletic League (PAL) play streets in survey (New York City), and a summary percentage for total pedestrian accident sample. Appendices A and B give data on comparative urban pedestrian accidents based on age and present selected play street observation forms, giving information on play street characteristics, street width and length, number of vehicles parked on street, percent of street being utilized for activities, type of barricade, sign legend, number of persons ob-

served using the street, activities observed, and additional notes.

by Martin L. Reiss; Allen E. Shinder
BioTechnology, Inc., 3027 Rosemary Lane, Falls Church, Va.
22042
Contract DOT-FH-11-8126
Rept. No. FHWA-RD-75-106; 1975; 85p 8refs
Work unit No. FCP-31E2032.
Availability: NTIS

HS-019 042

**SCHOOL TRIP SAFETY AND URBAN PLAY AREAS.
VOL. 4: A REVIEW OF DAYLIGHT SAVINGS TIME
RELATED STUDENT PEDESTRIAN PROBLEMS AND
COUNTERMEASURES. FINAL REPORT**

A two-phase study was made of the impact of reduced light conditions (under winter daylight savings time schedules) on school-trip safety. Phase one was the identification and categorization of increased school-trip safety problems associated with daylight savings time and the countermeasures in use to mitigate these problems. Problems identified include motorists' complaints about the difficulty in seeing children during dark periods; school-child pedestrian injuries, fatalities, and near misses; bussing difficulties due to poor visual conditions; personal observation; potential hazard; other categories such as weather or potential for molestation; news reporting; and lack of sidewalks. The second phase of the study involved a critique of identified countermeasures by the survey sample in terms of their accident reduction potential, cost, user acceptance, and implementation difficulties. Countermeasures studied include improved pedestrian conspicuity, augmented safety instructions or recommendations, improved crossing guard or patrol conspicuity, improved crossing site conspicuity, implemented bussing modifications, increased police activity, crossing personnel assignment changes, legal measures, and identification of hazardous crossings.

by Charlene Rosen; Wallace G. Berger
BioTechnology, Inc., 3027 Rosemary Lane, Falls Church, Va.
22042
Contract DOT-FH-11-8126
Rept. No. FHWA-RD-75-107; 1975; 43p 11refs
Work unit No. FCP-31E2032.
Availability: NTIS

HS-019 043

**SCHOOL TRIP SAFETY AND URBAN PLAY AREAS.
VOL. 5: GUIDELINES FOR THE DEVELOPMENT OF
SAFE WALKING TRIP MAPS. FINAL REPORT**

A set of procedures for developing and implementing safest school route maps is presented. The guidelines presented are primarily designed for traffic engineers. General procedures suggested for developing safest school route maps include: meeting with the board of education; preparing a base map; meeting with the school principal; inventory of walking areas; completing the inventory map, developing safest routes; another meeting with the school principal to correlate opinions and new information which may exist; developing handout maps; meeting with the Parents and Teachers Association to explain the program and to ask for assistance in distributing the maps and supervising the program; and finally evaluating the program while it is in operation. Community education and

involvement are considered the most important ingredients for successful use of the school trip safety maps. A variety of maps is illustrated to aid in map development.

by A. Shinder; H. Robertson; M. Reiss
BioTechnology, Inc., 3027 Rosemary Lane, Falls Church, Va.
22042
Contract DOT-FH-11-8126
Rept. No. FHWA-RD-75-108; 1975; 62p 16refs
Work unit No. FCP-31E2032.
Availability: NTIS

HS-019 044

**SCHOOL TRIP SAFETY AND URBAN PLAY AREAS.
VOL. 7: GUIDELINES FOR THE CREATION AND
OPERATION OF URBAN PLAY STREETS. FINAL
REPORT**

Guidelines for the creation and operation of urban play streets are presented. Information on the urban play street (a street temporarily closed to vehicular traffic while a variety of supervised recreational activities for all age groups take place) was gathered from surveys and field observations of the New York City and Philadelphia play streets, as previously described. Advantages of the urban play streets are emphasized as an incentive for their consideration by urban planners and policymakers, such advantages including both economy and increased safety conditions as well as various social and recreational values. Guidelines for development of such play streets are presented with detailed instructions on how a play street program is initiated, how streets for play activities are selected from candidate neighborhoods, criteria for traffic engineering surveys, street closure techniques, vehicular control, parking strategies, and street and user demographics. Appendix A provides a history of play streets in the United States. Appendix B is a summary of major findings and conclusions about recreation in 15 selected cities with emphasis on the high cost of conventional recreational facilities and patterns of utilization of such facilities as do exist. The Philadelphia play street information package which is provided to local community organizations (Appendix C) gives play street criteria and development suggestions. Expansion of the play street concept using a full-time recreation street not permanently closed to traffic is described in Appendix D. Appendix E describes play street games by rules and pavement layout. Bibliography of safety, recreation, play streets, and urban characteristics is provided in Appendix F.

by M. L. Reiss; A. E. Shinder
BioTechnology, Inc., 3027 Rosemary Lane, Falls Church, Va.
22042
Contract DOT-FH-11-8126
Rept. No. FHWA-RD-75-110; 1975; 96p 16refs
Work unit No. FCP-31E2032.
Availability: NTIS

HS-019 045

**SCHOOL TRIP SAFETY AND URBAN PLAY AREAS.
VOL. 6: GUIDELINES FOR PLANNING SCHOOL BUS
ROUTING AND SCHEDULING**

A set of procedures for planning and implementing safe school bus routing and scheduling was determined from review and synthesis of procedures used in the United States and from interviews with school officials and traffic engineers. Procedures

tasks described are: determining transportation needs; preparing school district map; determining hazards; developing criteria for routes and schedules; developing routes and schedules; periodic evaluation; and modification on a continuing basis. Transportation needs are identified through inventory of pupil needs, environmental conditions; and available resources. The school district map illustrates pictorially the data gathered in determining transportation needs. Hazards are identified by observation, study, and survey of the school district and its knowledgeable users, and are entered on the school district map. Criteria for development of routes and schedules are made dependent on parameters of distance and time of student travel. Development of routes and schedules involves selecting routes and services needed, creating those entities, and assigning busses, drivers, and students. Evaluation is accomplished through a proceduralized questionnaire relating problems to remedial actions. Modification may involve change in any facet of the transportation system and its participants, such as bus routes review, extension, or removal, or parental complaints. Two basic criteria are suggested for planning and implementing bus routing and scheduling: definitions of student need in terms of both distance and safety hazard.

by A. E. Shinder; H. D. Robertson; M. L. Reiss
BioTechnology, Inc., 3027 Rosemary Lane, Falls Church, Va. 22042
Contract DOT-FH-11-8126
Rept. No. FHWA-RD-75-109; 1975; 55p 20refs
For executive summary, see HS-019 039.
Availability: NTIS

HS-019 046

MOTOR CARRIER ACCIDENT INVESTIGATION. SAVAGE TRUCKING COMPANY, INC. ACCIDENT-- DECEMBER 6, 1975--HARTFORD, VERMONT

A motor carrier accident investigation report on an accident involving a truck (tractor trailer combination) operated by the Savage Trucking Company, Inc., Chester Depot, Vermont, is presented. The accident occurred 6 December 1975, 11:10 a.m., on Interstate 91, in the proximity of a bridge crossing State Route 14 and the White River, in Hartford, Vermont. The truck while traversing a downgrade S curve failed to negotiate the curve, overturned, and slid into the guardrail and bridge rail. Probable cause of the accident was determined to be excessive speed of the truck coupled with load shift, resulting in loss of control. Results of the accident were five fatalities, one injury, and \$29,000 property damage.

Bureau of Motor Carrier Safety, Federal Hwy. Administration, Washington, D.C. 20590
Rept. No. 75-6; 1975; 15p
Availability: Federal Hwy. Administration, Dept. of Transportation, Washington, D.C. 20590

HS-019 047

A PREDICTION OF RESPONSE OF THE HEAD AND NECK OF THE U.S. ADULT MILITARY POPULATION TO DYNAMIC IMPACT ACCELERATION FROM SELECTED DYNAMIC TEST SUBJECTS

Physical characteristics of the head and neck were measured on 18 male Navy volunteers who had previously undergone

testing on the dynamic impact acceleration sled facility at Michoud Station, New Orleans, La. Measurements performed include 55 standard anthropometric measures, 32 anthropometric measures of the seated subject, three dimensional head and neck range of motion, neck muscle reflex times in response to head jerks, and neck muscle voluntary isometric strength taken in both sagittal and lateral planes. Measurement results were used to establish parameter values for the MVMA-2D crash victim simulator data set in an attempt to reproduce the dynamic response of these volunteers to -Gx sled acceleration at 6 and 15 Gs. Procedures used for computing the various parameter values and comparisons between predicted and experimental results are presented. In addition, measurement data for 18-24 year females taken previously have been utilized to predict the dynamic response that would be expected if these subjects were tested at 6 and 15 Gs. Expansion of the data to predict response of the head and neck of the adult military population to dynamic impact acceleration will be performed.

by L. W. Schneider; B. M. Bowman; R. G. Snyder; L. S. Peck
University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich. 48109
Contract N00014-75-C-1077
Rept. No. UM-HSRI-76-10; NR 105-832; TR-1; 1976; 177p 26refs
Rept. for Apr 1975-Apr 1976.
Availability: Office of Naval Res., Biomedical and Medical Sciences Div., Arlington, Va. 22217

HS-019 048

LARGE-AREA DETECTION AT INTERSECTION APPROACHES

The relationship between controller operation and large-area detector design for intersection approaches was examined. Compromises that are forced on the traffic engineer in his efforts to reach his design objectives are exposed and clarified. Features of various available large-area detectors and their non-locking controllers are discussed in terms of advantages and disadvantages for use and safety. Specific applications for left-turn lanes, right-turn lanes, through lanes, hold capability, detection of small vehicles including motorcycles, and low and high speed approaches are discussed. Use of the limitations and criteria for safe application as outlined is recommended so that, if the detection system installed must fall short of the ideal because of limitations of budget or hardware capability, choice of equipment can be the result of trade-offs and compromises made intelligently and rationally with realization of the various parameters' effects on intersection efficiency and safety.

by Donald E. Holloman; Richard P. Kramer; Phil B. Nicholes; Harold M. Raynor, Jr.; David C. Ritchie; Thomas L. Stout; Peter S. Parsonson
Publ: Traffic Engineering v46 n6 p28-37 (Jun 1976) 1976; 55refs
See also "Small Area Detection at Intersection Approaches," published in Traffic Engineering, Feb 1974 (HS-014 355).
Availability: See publication

HS-019 049

RIGHT TURN ON RED

The right turn on red (RTOR) rule of each state in the United States is identified and experiences of these states with the

RTOR rule are described. Information on RTOR accidents, vehicle delay, fuel savings, and signing, as well as preliminary results of a public opinion survey of driver and pedestrian attitudes toward RTOR are reported. RTOR rules vary in kind from state to state, including permitted, permitted by sign or other signal, and totally prohibited. Factors considered in prohibiting RTOR in some locations include restrictive geometrics, multiple approaches, pedestrian volume, sight distance, intersection speeds, exclusive pedestrian phases, serious vehicle conflict, RTOR conflicts with other vehicle movements, history of accidents related to RTOR, complex signal phasing, signals under school crossing warrant, and miscellaneous conditions. RTOR effects on safety are shown to be generally positive rather than negative. Positive effects on vehicle delay and fuel savings are also cited. Pedestrian and driver reactions to permission for RTOR are generally favorable, but some enforcement problems remain.

by Hugh W. McGee; Davey L. Warren
Publ: Public Roads v40 n1 p19-31 (Jun 1976)
1976; 8refs
Availability: See publication

HS-019 050

HIGHWAY DESIGN FOR MOTOR VEHICLES--A HISTORICAL REVIEW. PART 6: DEVELOPMENT OF A RATIONAL SYSTEM OF GEOMETRIC DESIGN

An historical review has been made of the development of a rational system of geometric design as related to the planning and construction of highways for motor vehicles. The story of the development of geometrics describing side skid coefficient as related to vehicle occupant perception and comfort is told to illustrate the development of highway curve design. The early studies on such geometrics were carried out by volunteers in individual, self-selected road tests whose results were then reported and analyzed. From these data came proposals for design speeds for various road configurations. Percentile speed studies were performed by analyzing speeds adopted by drivers on roads already under traffic. Results of these analyses were used as the bases of road design for convenience, comfort, and safety. Further driver reaction research was conducted in braking for signals and conditions. The study of road design problems by government agencies and manufacturers, and in roadway innovations such as the German autobahnen and the Pennsylvania turnpike, are also discussed. With the increase in allowed speeds on public roads through the 1950's, testing for braking conditions and effects was begun according to road design parameters, and such data were incorporated into design standards. Policy on geometric design with relation to the design speed concept in highway engineering is also discussed; the standard text is "A Policy on Geometric Design of Rural Highways" by the American Association of State Highway Officials.

by Frederick W. Cron
Publ: Public Roads v40 n1 p9-18 (Jun 1976)
1976; 13refs
Availability: See publication

HS-019 051

THE BICYCLE AS A TRANSPORTATION MODE

Bicycles and legislation; the planning and design of bicycle facilities and of a demonstration bikeway; predicting the type

and volume of purposeful bicycle trips; development of planning process for a functional and recreational bicycle system; problems in integrating bicycle travel into the urban transportation planning process; citizen participation in bicycle planning from the public agency's viewpoint; establishing warrants for control of a bicycle crossing through simulation; and a highway safety standard for bicycle facilities are the subjects of the papers presented.

by Marjorie Moore
Transportation Res. Board, National Res. Council,
Washington, D.C.
Rept. No. TRR-570; 1976; 52p 48refs
Contains three reports prepared for the 53rd Annual Meeting and six reports prepared for the 54th Annual Meeting of the Transportation Res. Board. Includes HS-019 052--HS-019 058
Availability: TRB

HS-019 052

PLANNING AND DESIGN OF BICYCLE FACILITIES--PITFALLS AND NEW DIRECTIONS

Failures in bikeway design are reviewed for future guidance. Pros and cons of independent bicycle paths are listed, and the major deficiency is shown to be problems in design inasmuch as they are usually designed for pedestrians rather than for bicyclists. Several questions that planners face when considering an independent right-of-way opportunity are presented relating to safety, utility, linkage, and proximity to population centers. The use of sidewalks as bikeways is discussed, and unsatisfactory experience with such paths is presented. Some of the problems are poor sight distance, hazards from shrubs and signs, driveways, pedestrians, poor quality surface, and curbs. Various attempts at curb cuts and ramps are mentioned. Signed bike routes are rarely used by cyclists because they usually do not serve desired activity centers and offer few safety advantages. Bike lanes created from roadway space left over by motor vehicles are shown to be unsatisfactory though some negative behavior patterns have been modified by provision of such lanes. The need to acquire accurate before-and-after data on bikeways is discussed, as is the need for planners and designers to develop knowledge of good bikeway design. It is suggested that the best way to acquire sensitivity to bicyclists' needs and behaviors is to ride a bicycle.

by Daniel T. Smith, Jr.
DeLeuw, Cather and Co.
Publ: HS-019 051 (TRR-570), "The Bicycle as a Transportation Mode," Washington, D.C., 1976 p3-8
1976
Presented at the 53rd Annual Meeting, Transportation Res. Board, Washington, D.C.
Availability: In HS-019 051

HS-019 053

PLANNING AND DESIGNING A DEMONSTRATION ON BIKEWAY

The Seattle, Wash., bikeway committee has developed demonstration bikeway program that designated three bikeways, in order to test known design techniques and to devise methods unique to the constraints in Seattle. The first of the three demonstration bikeways is discussed, describing the incremental approach used to solve individual design problems. The first route was chosen because of its known

tion from all others. All possible solutions were developed for that element, and advantages and disadvantages of solutions were identified. A recommendation was made for each solution based on relative advantages and established planning and design criteria. A matrix of feasible design solutions was created and analyzed, allowing direct comparison of overall design effect and safety. An example of the incremental approach to solve a design problem and interaction of route elements is presented concerning a bikeway crossing on N.E. 65th Street. Some design decisions in the total bikeway created remain controversial, but generally its performance has exceeded expected goals.

by Robert D. Theisen

Seattle Traffic and Transportation Div., Seattle, Wash.

Publ: HS-019 051 (TRR-570), "The Bicycle as a Transportation Mode," Washington, D.C., 1976 p9-13
1976

Presented at the 53rd Annual Meeting, Transportation Res. Board, Washington, D.C.

Availability: In HS-019 051

HS-019 054

PREDICTING THE TYPE AND VOLUME OF PURPOSEFUL BICYCLE TRIPS

A method for determining which trips are most likely to be made by the bicycle if facilities are provided and for estimating the volume of those trips is described. Assumptions used as the basis for the prediction process are: a comprehensive system of bicycle facilities will exist in the Minneapolis-St. Paul area; and the maximum distance of a bicycle trip is 2 miles (3.2 kilometers). By using these assumptions it was determined the percentage of trip makers by trip type who could make their trips by bicycle. The factors affecting bicycle use are discussed, including flexibility of schedule, average trip length, age of trip maker, availability and cost of automobile storage, cargo needs of trip, street congestion, quality of pedestrian system, and transit availability. The effect of these factors on the probability of bicycle use to go to work, shopping, school, personal business, or recreation was considered. A cumulative percentage of home-based bicycle trips by time and purpose was figured, and vehicular trips that could be attracted to the bicycle in the metropolitan area were estimated. In addition, an accounting was made of home-based vehicular trips in 1970 in the metropolitan area by purpose and mode for comparison purposes with the bicycle estimates. It is concluded that trips whose schedule is flexible have a greater probability of being made by bicycle. Therefore, bicycle systems designed to accommodate trips whose schedule is rigid, such as work and school trips, are not recommended.

by Carl E. Ohrn

Barton-Aschman Assoc., Inc.

Publ: HS-019 051 (TRR-570), "The Bicycle as a Transportation Mode," Washington, D.C., 1976 p14-8
1976

Presented at the 54th Annual Meeting, Transportation Res. Board, Washington, D.C.

Availability: In HS-019 051

ESTABLISHING WARRANTS FOR CONTROL OF A BICYCLE CROSSING THROUGH SIMULATION

A simulation model calibrated from data collected where bicycles cross a two-lane, two-way street was developed for a crossing controlled by a yield sign to bicycles. Experimentation was done with the model to determine delay and queue formation of bicycle traffic. Various levels of motor vehicle and bicycle demands were tested with the model. Situations in which a yield sign to bicycle traffic are ineffective at a crossing are discussed, including impedance of bicycle traffic above 75% when bicyclists begin to take chances by crossing during inadequate gaps in traffic, total delays exceeding those which would be produced by stop signals, and instances of free yielding by motorists to allow bicycle queues to pass. Warrants for signalization are suggested based on these situations: crossings handling approximately 1,000 vehicles per hour need signalization to prevent bicyclists from taking unsafe chances in crossing between traffic gaps; crossings handling fewer vehicles per hour need signalization for total delay of traffic in turn when other safety criteria warrant the delays created in both transportation modes; at crossings where bicycle queues reach a length of six each 15 minutes, signalization for total delay is recommended. Three output variables of the model were used to establish the warrants for signal installation: percentage of bicycles delayed (to insure adequate gaps), total delay to bicycles, and maximum queue length occurring in 15 minutes. Additional comments are offered as an aid in selection of crossing controls.

by Thomas C. Ferrara

University of California, Davis, Calif.

Publ: HS-019 051 (TRR-570), "The Bicycle as a Transportation Mode," Washington, D.C., 1976 p20-3
1976; 6refs

Presented at the 54th Annual Meeting, Transportation Res. Board, Washington, D.C.

Availability: In HS-019 051

HS-019 056

PROBLEMS IN INTEGRATING BICYCLE TRAVEL INTO THE URBAN TRANSPORTATION PLANNING PROCESS

A comparison between the use of the bicycle with use of other modes of urban transportation is made, showing that bicycle travel closely resembles motor vehicle travel and requires the same planning information and safety provisions as vehicular traffic requires. Information on intraurban bicycle travel was gathered in Sweden which demonstrates that when bicycle ownership is high and when planners treat the bicycle as a viable means of transportation the bicycle is used extensively in daily travel for a variety of trip purposes. In planning for bicycle facilities in United States cities, it is recommended that the recreational aspects of bicycling be subordinated to viable transportation aspects. It is suggested that bicycling will increase in intraurban areas when it is integrated into the urban transportation planning process like other urban transportation modes. Comments and authors' remarks are offered

on the development of bicycle use data in the United States as a basis for meaningful planning.

by Susan Hanson; Perry Hanson
State Univ. of New York at Buffalo, Buffalo, N.Y.
Publ: HS-019 051 (TRR-570), "The Bicycle as a Transportation Mode," Washington, D.C., 1976 p24-30
1976; 20refs
Presented at the 54th Annual Meeting, Transportation Res. Board, Washington, D.C. Discussion of the paper by Kenneth Markve, Metro-Transportation Program, New Orleans, La. is appended, followed by authors' closing remarks.
Availability: In HS-019 051

HS-019 057

CITIZEN PARTICIPATION IN BICYCLE PLANNING FROM THE PUBLIC AGENCY'S VIEWPOINT: WHY AND IS IT WORTH THE EFFORT?

An examination of reasons that many highway departments lack good knowledge related to bicycling and bicyclists is presented, including training, personal transportation modes, and logistics. The characteristics of contemporary bicyclists and their needs are presented, with discussion and evaluation of bikeway design criteria as related to the lack of knowledge on the part of designers and planners. Contemporary bicyclists are overwhelmingly youthful (94% under 40 years of age), and perceive three major obstacles to bicycling routinely: lack of bikeways, lack of bike-storage facilities at destinations, and conflicts with automobile traffic. With regard to future planning criteria and activities, some courses of action are recommended to attract broad public support and to increase traffic safety of bicyclists: initiate a program to reduce the hit and run problem in mixed traffic; enforce regulations controlling motor vehicle emissions; make pedestrian and bicyclist access part of new traffic system improvements; provide safe, attractive bicycle paths; and assign agency personnel and resources to the bicycle field and include them in decision making and planning. As an example of bicyclists' needs, the circumstances of Chief Justice Warren E. Burger's bicycle accident are examined, and it is shown that causal factors were the responsibility of public agencies.

by Cary S. Shaw
Cary Shaw and Assoc., Washington, D.C.
Publ: HS-019 051 (TRR-570), "The Bicycle as a Transportation Mode," Washington, D.C., 1976 p31-7
1976; 21refs
Presented at the 54th Annual Meeting, Transportation Res. Board, Washington, D.C.
Availability: In HS-019 051

HS-019 058

A HIGHWAY SAFETY STANDARD FOR BICYCLE FACILITIES

Development of a highway safety standard for bicycle facilities is discussed in aspects of guidance to planning and construction activities and in long-range consideration of education for bicycle safety enforcement of regulations and laws, and engineering design criteria. The Highway Safety Act of 1973 requires that bicycle safety provisions be incorporated into highway safety standards, and the Federal Highway Administration is given responsibility for development of a standard to encourage safe operation of bicycles in the highway environment through improved traffic engineering practices

and physical facilities. In some instances, no physical improvements are indicated, but in other instances the widening of the outside travel lane or paving of the highway shoulder may be required. Some situations indicate the need for a bicycle roadway separate from high-speed motor vehicle traffic. The standard being developed will guide appropriate officials in the planning and construction of safe and usable bicycle facilities as a portion of the total bicycle-motor vehicle safety conflict.

by Jerrold A. Kaplan
Urban Planning Div., Federal Hwy. Administration
Publ: HS-019 051 (TRR-570), "The Bicycle as a Transportation Mode," Washington, D.C., 1976 p38-44
1976; 1ref
Presented at the 54th Annual Meeting, Transportation Res. Board, Washington, D.C.
Availability: In HS-019 051

HS-019 059

TRANSPORTATION ISSUES SYMPOSIUM, SEPTEMBER 17, 18, 19, 1975

Papers and panel reports given at a symposium on transportation issues, sponsored by The Mitre Corporation, 17-19 September 1975, are presented. After introductory remarks by Charles Zraket of the Mitre Corporation, papers were presented as follows: Keynote address: Congress and transportation; Urban transportation; Intercity rail transportation; Motor carrier transportation; Air transportation; Department of Transportation policy. Panel reports were given on: Transportation regulation; Urban transportation; Air transportation; Transportation of freight; Transportation R&D policy; Intercity group passenger transportation; Automobile issues. A report on the panel discussions in retrospect considers some underlying concerns and views recurring throughout the symposium. They include need for explicit statement of a national transportation policy by Federal government, lack of correlation of transportation agency programs and activities in order to eliminate duplication of effort and conflicting criteria and priorities, poor coordination of government funding and regulatory processes, inequities of transportation users' charges, need for a systems approach to planning and regulation of transportation, disagreement on methodology for measuring and analyzing transportation services, concern over mounting expenditures for research and development in the transportation area, and the phenomenon of programs working at cross-purposes to accomplish similar objectives.

by Kathi Luckard; Dorothy Berks, eds.
The Mitre Corp., Westgate Res. Park, Mail Stop W010, McLean, Va. 22101
Rept. No. M76-14; 1975; 205p 2refs
Presented at the Symposium on Transportation Issues, 17-19 Sep 1975, sponsored by The Mitre Corp., McLean, Va.
Availability: Corporate author

HS-019 060

GO FOR DRIVER EDUCATION. DRIVER EDUCATION STUDENT DRIVING MANUAL

A driver education student driving manual is presented which includes information on techniques and procedures to teach proper operation of a motor vehicle, to experience car control and car use, to develop proper visual habits necessary for driving, and to relate skills and methods of defense and courtesy to driving practices. Operation of the vehicle is covered

every technical and experiential detail from predriving habits and preparation to involvement in complex traffic situations. Experience in car care and use is instructed with emphasis on safety and economy. Visual practices instruction includes techniques for scanning other traffic, and driving conditions for safety and planning input. The skills in driving and taking care of a motor vehicle are taught by means of a procedural task assignment, requiring individual decisions according to the circumstances met. Information is also provided for driving in emergency conditions.

Memphis City Schools, Dept. of Instruction, Memphis, Tenn. (n.d.); 57p
Used in Secondary Level (Grades 9-12), Memphis City Schools.
Availability: City Council, Room 504, City Hall, 125 North Main St., Memphis, Tenn. 38103

HS-019 061

SOCIAL AND ECONOMIC FACTORS AFFECTING FUTURE AUTOMOBILE USAGE (DRAFT)

Social and economic factors affecting future automobile usage were investigated using forecast data, highway statistics, economic reports, population statistics, environmental data, highway user demography, and data on future energy use and resources. The past trend in automobile usage is characterized as steady increase enabled by improvement and necessity of automobiles in a society which increasingly provided automobile facilities. Two types of usage models were prepared to discover and project trends documented from the past and probable for the future: aggregate (examining trends in underlying factors relative to historical travel data and projecting both factors and future travel expectations) and disaggregate (classifying and enumerating user groups, measuring their rates of usage, and projecting populations and rates of usage to obtain future travel estimates). Effects of individual factors within demographic, economic, and fuel supply categories were calculated from traffic surveys and studies. Government efforts to adapt the automobile to trends foreseen in usage include development of new fuel/energy sources, improvement of vehicular fuel efficiency, and regulation of drivers through licensing and usage limits. The Department of Transportation Automotive Energy Efficiency Program (AEEP) is described, comprising policy studies and experimental research on fuel consumption and efficiency in relation to factors of emissions, safety, economics, consumer demands, and projections as a function of national and individual variables. AEEP studies indicate that the new model fleet of 1980 can realize a 20% fuel economy improvement compared to 1974, utilizing improved weight/power ratios, drive trains, radial tires, and engine design. All indications are that fuel supply constraints are the principal factors in determining the trend in future automobile usage.

by Arrigo P. Mongini; John E. Harman
Department of Transportation, Washington, D.C.
1975; 50p 15refs
Presented to the Transportation Res. Board, Univ. of Michigan, Ann Arbor, 4 Aug 1975.
Availability: Reference copy only

HS-019 062

TEST PROCEDURES FOR THE EVALUATION OF AERODYNAMIC DRAG ON FULL-SCALE VEHICLES IN WINDY ENVIRONMENTS

The procedures and instrumentation necessary to conduct full-scale field tests on tractor-trailer trucks using the coast-down method to determine aerodynamic drag are presented. Since coast-down tests determine the total drag, it is necessary to evaluate the mechanical drag forces and the gravitational effects in order to obtain the aerodynamic drag. Mechanical drag forces consist of driveline drag and rolling resistance. Driveline drag has been evaluated herein, while rolling resistance can be evaluated from subsequent analysis of the coast-down data. The driveline drag torque was found to consist of a term due to coulomb damping and a term directly proportional to vehicle speed. During the coast-down tests the vehicle ground speed, and the air speed and direction relative to the vehicle were continuously monitored, filtered, digitized, and stored for later analysis. Wind tunnel tests indicated that vehicle interference necessitates correcting the wind speed and direction obtained from the boom-mounted anemometer in order to obtain the true values. Analysis of the data will be used to correlate the full-scale results with previous wind tunnel tests.

by William H. Walston, Jr.; Frank T. Buckley, Jr.; Colin H. Marks
University of Maryland, Mechanical Engineering Dept., College Park, Md.
Grant NSF SIA74-14843
Rept. No. SAE-760106; 1976; 12p 7refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 063

THE DUMMY MISSILE PROJECT

A rocket-propelled passenger car carrying two anthropomorphic dummies was impacted into a concrete abutment at 52 mph to study tornado force vulnerability and effects, and to develop some appropriate visual aids for safety education purposes. Data presented on impact effects on the dummies tested indicate that human passengers would have been killed in the same circumstances. Damage to the car and to the dummies carried in the car is described and illustrated. The impact forced the bumper grille and radiator backward two feet two inches, front wheels and engine were also forced rearward, and tires remained intact and inflated. The front seat moved forward 18 inches at impact, breaking the shoulder harness strap on dummy 1 seven inches from the bolted end. The dummy destroyed the steering wheel, bent the steering column, veered to the right, and passed the steering wheel, striking the windshield with its head and the dashboard with its knees and hands. The lap belt on dummy 1 showed some structural deformation, but remained intact. Dummy 2 (unrestrained) moved forward into the dashboard and windshield, its head shattering it and knocking it loose from the mounting, and destroying the windshield wiper apparatus. Several large and small dents appeared in the roof of the car, over rear doors, and in the kick plate below the front door. Neither rear door could be opened by hand. The duration of the forces of deceleration was approximately 60-80 ms. Com-

puter plotted graphs of the acceleration forces are also provided.

by Lee Stinnett
Sandia Labs., Albuquerque, N.M. 87115
Contract AT(29-1)-789
Rept. No. SAND75-0360; 1975; 63p 4refs
Availability: NTIS
1976; 67p 13refs
Environmental Health Effects Res. Series.
Availability: NTIS

HS-019 065

ASSESSMENT OF TOXICITY OF AUTOMOTIVE METALLIC EMISSIONS. VOL. 2: RELATIVE TOXICITIES OF AUTOMOTIVE METALLIC EMISSIONS AGAINST LEAD COMPOUNDS USING BIOCHEMICAL PARAMETERS. FINAL REPORT

Toxicity of automotive metallic emissions were tested in rats using biochemical parameters. Intraperitoneal administration of platinum or palladium compounds at levels of 28 or 56 micromoles/kg body weight caused decreased radioactive thymidine incorporation into DNA (deoxyribonucleic acid) of spleen, liver, and testis, with the spleen being most sensitive to both salts. Effects of salts of platinum or palladium administered by intraperitoneal injection or ingestion were determined on parameters of the microsomal mixed function oxidase system from rat liver, giving increased hexobarbital-induced sleeping time in vivo and generally decreased aminopyrine demethylase in vitro and the microsomal content of cytochrome P-450 (after intraperitoneal injection), and general decrease or negligible effect on parameters of drug metabolism for one week and slightly increased these parameters after four or more weeks (ingestion). Lethal dose studies are reported following intraperitoneal or oral administration of salts of lead, manganese, platinum, and palladium with respect to their effect on the growth rate of rats, organ weight of five tissues (liver, kidney, spleen, heart, and testis), and the tissue content of DNA, RNA (ribonucleic acid), and protein. Large oral dosage was required to restrict the weight gain of the rats, and organ weights were unaffected except in the administration of lead salts.

by David J. Holbrook, Jr.
University of North Carolina, School of Medicine, Chapel Hill, N.C. 27514
Contract 68-02-1701
Rept. No. EPA-600/1-76-010b; PB-251-232; 1976; 69p 3refs
Environmental Health Effects Res. Series.
Availability: NTIS

HS-019 066

1974 CRC OCTANE NUMBER REQUIREMENT SURVEY

A test program on 1974 model cars was conducted, including determinations of maximum octane number requirements under full and part throttle operating conditions and observations of surface ignition knock and rumble. A random sample of cars having a minimum of 5000 deposit miles was tested, using the following fuels: tank fuel, constant 11 sensitivity full boiling range unleaded fuel, average sensitivity full boiling range unleaded fuel, constant 8 sensitivity full boiling range unleaded fuel, constant 8 sensitivity full boiling range leaded

fuel, primary reference fuel, high sensitivity full boiling range unleaded fuel, and average sensitivity full boiling range leaded fuel. Maximum octane number requirements for all cars tested are presented in tabular format for 50 and 90% car satisfaction levels. Requirements of all cars including imports were 0.2 octane number lower than the 1973 models tested on primary reference fuels at the 50% satisfaction level. Speed for maximum octane number requirement with different fuels was also determined. Phenomena of part throttle knock, tank fuel knock, surface ignition and rumble, road octane number depreciation, speed range octane number requirements, and gear position for maximum requirements were also studied, reported, and compared with 1973 models tested previously. Procedures for carrying out the tests and for analyzing data are described in detail. Results are presented in tabular and chart formats.

Coordinating Res. Council, Inc., 30 Rockefeller Plaza, New York, N.Y. 10020
Rept. No. CRC-479; 1975; 185p
Prepared by the Analysis Panel of the Octane Number Requirement Survey Group. CRC Proj. CM-101-74.
Availability: Corporate author

HS-019 067

HIGH MILEAGE SUPPLEMENT TO THE 1973 CRC OCTANE NUMBER REQUIREMENT SURVEY.

A program of research was carried out to compare octane number requirements on 1973 model cars at the 20,000 mile (or higher) level with those obtained at the 5,000 mile (minimum) level, in order to supplement test data previously gathered under a maximum limit of 16,000 miles. Three selected model cars were chosen, using an estimated 20 cars per model. Reference fuels used in the study included primary reference fuel (PR), average sensitivity full-boiling range unleaded (FBRU), high sensitivity full-boiling range unleaded (FBRSU), and average sensitivity full-boiling range leaded (FBR). Octane number requirements were measured and compared with previously measured requirements. All test cars were tested on PR, FBRU, and FBRSU reference fuels, but insufficient data were obtained on the leaded FBR reference fuel to develop an octane satisfaction curve. Procedures for plotting octane number requirement satisfaction curves are described. Results are presented in tabular and chart formats.

Coordinating Res. Council, Inc., 30 Rockefeller Plaza, New York, N.Y. 10020
Rept. No. CRC-480; 1975; 22p 1ref
Prepared by the Analysis Sub-Panel of the Analysis Panel for the 1973 CRC Octane Number Requirement Survey. CRC Proj. CM-98-73.
Availability: Corporate author

HS-019 068

REPORT OF THE CRC 1975 DIESEL PISTON RATING SYMPOSIUM.

A report is given of findings of the first Coordinating Research Council, Inc., (CRC) Diesel Piston Rating Symposium conducted in San Antonio, Texas, 3-7 Mar 1975. The objective of the symposium was to evaluate the precision of the new CRC Diesel Piston Rating System (revised Oct 1974) and to determine if modifications to the method and/or new techniques are required. Piston types selected for rating included Caterpillar, Mack, Detroit Diesel, Nissan, and Petter. Factors heretofore

stated in such a way as to be in conflict with international counterpart procedures were identified, and recommendations were formulated to make various rating systems compatible. Results of the investigation show that mean piston ratings for sets of ratings compared using different rating systems were in good agreement. Standard deviations for mean ratings and standard deviations as a mean percent of mean ratings were large, indicating a big difference among raters. Problems involved with rating are not related to the zone of the piston rated but rather to classifying the type of deposit and the area covered. The large standard deviations found during rating are unacceptable for specified objectives. A panel consisting of those individuals who spend a large part of their time rating diesel pistons could meet periodically in order to reach better agreement in classifying different types of piston deposits and to identify and resolve other rating problems. Some specific recommendations made by the first panel to so convene are outlined to aid in standardization of ratings.

Coordinating Res. Council, Inc., 30 Rockefeller Plaza, New York, N.Y. 10020
Rept. No. CRC-481; 1975; 63p
Prepared by the Diesel Piston Rating Symposium Panel of the CRC Diesel Rating Methods Group. Additional data is available from the Coordinating Res. Council, Inc., 30 Rockefeller Plaza, New York, N.Y. 10020. CRC Proj. CD-16-73.
Availability: Corporate author

HS-019 069

1972 CRC INTERMEDIATE TEMPERATURE DRIVEABILITY PROGRAM - PASO ROBLES.

A series of automobile road tests was carried out to develop a research technique for determining interaction of fuel volatility and automotive driveability on the road at ambient temperature ranges of 40 to 50 degrees and 60 to 70 degrees Fahrenheit. Matched sets of 16 cars were run at the two temperatures to investigate the effect of these temperatures on driveability. Fuel volatility effects were investigated by nine different volatility fuels which provided independent variations of 10, 50 and 90% evaporated point distillation temperatures. Special efforts were made in training and selecting drivers in order to minimize rater variability. Principal findings were that large differences existed between raters in evaluating the severity of malfunctions (subjective ratings) even after training. Rater severity factors were developed on a limited number of cars and fuels and applied to other independent data. Ambient temperature differences of 40 to 50 degrees compared to 60 to 70 degrees were not found to have significant effect on cold start and warm-up driveability or on the response of such driveability to fuel volatility. Significant differences in driveability existed between cars, even of matched make and model. Cold start and warm-up driveability was affected by fuel volatility, but cars responded differently to fuel volatility in three categories: pre-production quick-choke cars, two matched production cars, and other cars used. Best fit regression equations were developed for the three car response categories discussed. Surge and idle roughness were found to have little response to fuel volatility. Warmed-up driveability as measured was not affected by fuel volatility with the test procedure used. Standard deviation of repeat runs was about 30 total weighted demerits, a value of 20 to 30% of the average adjusted demerit values encountered. Specific recom-

mendations are made for rater selection and training in future programs for evaluating driveability.

Coordinating Res. Council, Inc., 30 Rockefeller Plaza, New York, N.Y. 10020
Rept. No. CRC-483; 1975; 109p 2refs
Prepared by the CRC-Analysis and Report Writing Panel (Re: 1972 Intermediate Temperature Program) of the CRC-Motor Volatility Group. CRC Proj. CM-94-72.
Availability: Corporate author

HS-019 070

TRAVEL SURVEY PROCEDURES FOR STATEWIDE TRANSPORTATION PLANNING: HOUSEHOLD/ROADSIDE/MODAL-SURVEYS

Types of survey procedures covered are household, roadside, modal, and specialized. The survey types are assessed for potential use, advantages, disadvantages, strengths, and limitations in aspects of objectives, applicability, locations, procedures, sample parameters, instrumentation, cost-efficiency, and staffing. Household surveys (home interview, telephone, and mail) can be used to characterize travel for policy or planning studies; to monitor over time changes in travel caused by fuel supply variations, government policy, and demographic behavior; and to collect socioeconomic, attitudinal, and behavioral data related to travel. Home interview household surveys are most expensive and most reliable for administering long or complex instruments, and are best suited for collecting data on frequent and nonspecific statewide travel. Lower cost telephone and mail surveys are less reliable, but may be useful in mass application. Roadside surveys (urban cordon and multiple screenline, stateline cordon in combination with a follow-up survey of another type, and recreation/peak travel period) provide data to develop trip generation, distribution, and traffic assignment procedures for highway planning. Limitations of roadside surveys include limited data on total tripmaking and on socioeconomic and attitude characteristics, substantial cost, traffic congestion, and safety hazards. Advantages are directness and specificity. Modal surveys (on-board and terminal air passenger, on-board intercity bus and rail passenger, and ramp and mail general aviation passenger) have the advantages of specific interception of users and the opportunity to correlate combination transportation facilities and services usage characteristics. Disadvantages are dependence on facilities personnel for cooperation and administration and temporality of data. Four appendices illustrate instruments, costs, and procedures for: household surveys - New York, Kentucky, Connecticut, and in the Nationwide Personal Transportation Study; roadside surveys - Minnesota, the Northeast Corridor, California, Kentucky, New York, and Oklahoma; modal surveys - Pennsylvania, Michigan, New York, Wisconsin, and the Northeast Corridor; and specialized surveys, including attitudinal surveys in New York and Wisconsin, recreation travel survey in Kentucky, and travel surveys of the rural poor.

by John F. DiRenzo
Peat, Marwick, Mitchell and Co., 1025 Connecticut Ave., N.W., Washington, D.C. 20036
Contract DOT-FH-11-8592
Rept. No. HHP-12 ; 1976; 151p 38refs
Availability: Limited availability; Methods Branch, Program Management Div., Office of Hwy. Planning, Federal Hwy. Administration, Washington, D.C. 20590

ANALYTICAL DESCRIPTION OF THE MODERN STEAM AUTOMOBILE

An analytical description of the modern steam automobile represents the sensitivity of operating conditions on performance parameters such as engine displacement, gear ratio, fuel/air ratio, characteristics of the working medium, and supply temperature and pressure. A third order of analysis used to evaluate efficiency of performance of the steam engine uses the Mollier chart, pressure/volume diagrams, and operational functions as descriptive techniques. Mileage data derived show that miles per gallon do not continue to increase with thermal efficiency, so that fuel economy is differentially defined in terms of objectives and resources. Steam generator efficiency is defined in terms of power and torque. No conclusion is given on the preferred steam engine configuration after a discussion of hardware design. Performance data using water as the working medium for analysis show that the engine is sensitive to temperature parameters (800-900 degrees Fahrenheit are required for acceptable performance), and that performance is a weak function of pressure above 800 psia. The practical limit of operating efficiency for automotive application is given as 70 mph after 25 seconds with a fuel consumption of 15.4 MPG with 0.5 lb/min of fuel input. Research into super performance steam engines has been problematical due to consequences of using high temperatures and pressures with very little practical gain in performance. Techniques for determining: the relationship between MPG and other parameters characteristic of the steam engine, total gear ratio required for the engine, abatement number limitations on vehicle speeds, count number for fuel use rate, and pressure changes taking place within a steam engine cylinder are given in appendices.

by Jerry A. Peoples
George C. Marshall Space Flight Center, Marshall Space Flight Center, Ala. 35812
Rept. No. M-TU-75-7; N75-14134; 1974; 141p 11refs
Miscellaneous report, prepared by Program Development.
Availability: NTIS

SYMBOL SIGNS: THE DEVELOPMENT OF PASSENGER/PEDESTRIAN ORIENTED SYMBOLS FOR USE IN TRANSPORTATION-RELATED FACILITIES. FINAL REPORT

The American Institute of Graphic Arts (AIGA) in cooperation with the U.S. Department of Transportation (DOT), Office of Facilitation, has created 34 passenger- and pedestrian-oriented symbols for use in transportation-related facilities. The consistent and interrelated group of symbols was produced to bridge the international language barrier and to simplify basic messages needed at domestic and international travel facilities. The working development process attempted to take full advantage of strong and widely recognized existing symbol concepts and to introduce new symbol forms only where no satisfactory concepts existed. Detailed descriptions of the process employed to create the symbols as well as guidelines for their use are included. Color and black and white illustrations of the symbols are also included. Signals developed are in four categories. The public services category represents services widely used in transportation-related facilities and seven additional messages to represent all common public transportation modes: telephone, mail, currency exchange, first aid, lost

and found, baggage lockers, elevator, toilets (men), toilets (women), toilets, information, hotel information, taxi, bus, ground transportation, rail transportation, air transportation, heliport, and water transportation. The concessions category includes messages related to commercial activities: car rental, restaurant, coffee shop, bar and shops. The third category, processing activities, was developed for messages representing important passenger-related procedures: ticket purchase, baggage check-in, baggage claim, customs, and immigration. The fourth category, regulations, includes: no smoking, smoking, no parking, parking, and no entry. Appendix A presents a symbol sources inventory by several travel associations and facilities. Appendix B provides an example of the symbol concept evaluation sheet. Appendices C and D list the American Institute of Graphic Arts Signs and Symbols Committee biographies and the Department of Transportation Advisory Committee members. Selected bibliography is presented in Appendix E.

American Inst. of Graphic Arts, 1059 Third Ave., New York, N.Y. 10021
Contract DOT-OS-40192
Rept. No. PB-239-352; 1974; 173p 18refs
Rept. for Jul 1974-Nov 1974. Sponsored by the Office of Facilitation, Assistant Secretary for Environment, Safety, and Consumer Affairs, Dept. of Transportation, Washington, D.C. 20590.
Availability: NTIS

AUTOMOBILE INSURANCE LOSSES. COLLISION COVERAGES. ANNUAL INCREASES AND SEASONAL VARIATIONS 1972, 1973, 1974 AND 1975 MODELS

A study was carried out to investigate recent trends and seasonal variations in collision coverage loss experience covering the experience of private passenger vehicles for model years 1972, 1973, 1974, and 1975. Results of the study describe variations in both frequencies and sizes of claims under collision coverage, that is insurance covering damage to the insured vehicle itself. Complications in making such comparisons are enumerated, and the methodology of the present study has been explicitly changed to meet these difficulties in analysis. Results indicate that monthly seasonal variations in claim frequencies were pronounced and differed for vehicles garaged in northern states compared with southern states. Vehicles garaged in northern states had above-average claim frequencies during winter months and below average for the remainder of each year; but vehicles garaged in southern states had below-average claim frequencies for the first four months of each year and about average or slightly above-average results the rest of the year. Monthly seasonal variations in average loss payments were less pronounced and did not show major differences among regions. Overall trends in claim frequencies showed a decline throughout most of the three-year period 1973 through 1975. Trends in average loss payments increased throughout most of the period. Claim frequency trends for 1972 and 1973 models were essentially the same for most of the period. Comparisons between the results for 1972 and 1973 models suggest that bumper designs of the 1973 models have resulted in some reduction in claim frequencies, but differences between claim frequencies for the best and worst of the major market classes within each model year were much larger. Average loss payment trends for 1972 and 1973 models had the same patterns, but the 1973 model values were consistently higher. Results presented for 1974

ments were much higher than corresponding results for earlier models.

Highway Loss Data Inst., Watergate 600, Washington, D.C. 20037
Rept. No. HLDI A-7; 1976; 47p 5refs
A bibliography of other research reports published by the Highway Loss Data Inst. is included.
Availability: Corporate author

HS-019 074

AUTOMOBILE INSURANCE LOSSES. COLLISION COVERAGES. INITIAL RESULTS FOR 1976 MODELS

Variations in both the frequency and size of collision claims for damage to 1976 model year private passenger vehicles of 12 domestic and 11 foreign makes during their first six months of availability (September 1975 through February 1976) are described. Information is based on data from collision coverages, that is insurance covering damage to the insured vehicle itself, supplied by seven insurance companies: Allstate, Kemper, Liberty Mutual, Nationwide, Prudential, State Farm, and Travelers. Categories of information covered include standardized results for all series combined, standardized results for market classes and individual vehicles, variations between individual vehicles, variations within market class and body style, comparisons between market classes, comparisons between 1976 and earlier model year results, claim frequency details by make and series, and average loss payment details by make and series. Descriptions of the sources and nature of data and the method of data analysis are presented in Appendices A and B, respectively. An appendix of definitions (C) and an appendix of vehicle series designations for 1976 models (D) are also appended.

Highway Loss Data Inst., Watergate 600, Washington, D.C. 20037
Rept. No. HLDI R76-1; 1976; 44p 3refs
A bibliography of other research reports published by the Highway Loss Data Inst. is included.
Availability: Corporate author

HS-019 075

HISTORY OF EMERGENCY MEDICAL SERVICES IN THE UNITED STATES

An historical survey of the development of emergency medical services in the United States is presented. While commendable volunteer services for emergency medical aid existed traditionally in many locations, adequate training and equipment for care were often lacking. Moreover, hospitals were not prepared to accept emergency patients. A review of accident and fatality statistics shows that such emergency care could save thousands of lives and provide better treatment for millions of nonfatal injuries. Organized medicine and government agencies have been the major stimuli in improving emergency medical care through program development and personnel training. The National Highway Traffic Safety Administration 81-hour Emergency Medical Technician (EMT) course is described as one of the innovations in training for such service. Other training programs are also described in terms of coverage, objectives, and applications. Useful texts developed for such courses of training are listed and evaluated, and sup-

Milestones in progress toward a comprehensive emergency medical service system in the United States are listed, and recommendations for furthering the development of that system are given. It is hoped that EMTs will be recognized in terms of career status comparable to police and fire-department personnel or to nurses. Their community status is important.

by Charles A. Rockwood, Jr.; Coleen M. Mann; J. D. Farrington; Oscar P. Hampton, Jr.; Robert E. Motley
University of Texas Medical School at San Antonio, Div. of Orthopaedics, San Antonio, Tex.
Publ: Journal of Trauma v16 n4 p299-308
1976; 45refs
Availability: 7703 Floyd Curl Dr., San Antonio, Tex. 78284

HS-019 076

FIRST RESPONDER-EMERGENCY MEDICAL CARE TRAINING

Research in developing systems and guidelines in which emergency medical care will be brought more promptly to victims of trauma and acute illness is reviewed. Programs sponsored presently by the National Highway Traffic Safety Administration-Emergency Medical Services program encompass first responder programs for both professional agencies and the general public. Research studies have shown that 50% of those who die from traumatic injuries die outside the hospital emergency department, and that 70% of the nation's traffic fatalities occur in rural areas. Whereas urban population accounts for 60% of the total, emergency response in urban areas as well as rural areas may be ineffective due to the time elapse before victims can be given medical aid. Some ambulance response statistics are reviewed to show that response time may be misleading in indicating service to victims. Some systems for emergency medical care delivered to victims before ambulance arrival have been devised and described in Wisconsin, Wyoming, Illinois, Nebraska, Washington, D.C., and Washington. Training elements for first responders are described and advocated, and programs for developing such services and for training citizens for participation are recommended.

by Robert E. Motley
Department of Transportation, Emergency Medical Services Branch, Washington, D.C. 20590
1976; 12p 13refs
Presented at the U.S.A. Bicentennial Emergency Medical Services and Traumatology Conference, Baltimore, 10-12 May 1976.
Availability: Author will supply copies.

HS-019 077

REEDUCATION AND REHABILITATION OF THE DRUNKEN DRIVER

A course for reeducation and rehabilitation of the drunken driver has been developed in Arizona, called DWI Phoenix. The development approach for the program and efforts to evaluate it are described, and guidelines for identifying and helping problem drinkers among participants are suggested. The course content is based on studies of 1,000 DWI (driving-while-intoxicated) violators, including details of their arrest and history of violations, tests and interviews of the subjects

studied in mind. Four class sessions comprise the DWI Phoenix, including statistics and visual aids to indicate the seriousness of DWI, physiological effects of alcohol on motor abilities, problem drinking characteristics, and individual planning to modify behavior to avoid future drunken driving. Tests administered at the beginning and at the end of the course supply data for evaluation of the course as well as for referral counseling of participants. Evaluation of the DWI Phoenix as conducted from 1966 through 1973 resulted in some 40 major revisions of organization and content, involving the need for specific behavior modification instruction and follow-up counseling opportunities. The evaluation of the effectiveness of the course showed signs of improving knowledge and attitude and subsequent behavior of participants. Guidelines for assisting the problem drinker are presented in areas of data collection and utilization, identifying problem drinkers, providing separate rehabilitation for problem drinkers, and the use of community referral agencies and counselors.

by James L. Malfetti
Columbia Univ., Teachers College, New York, N.Y.
Publ: Journal of Drug Issues p255-69 (Summer 1975)
1975; 23refs
Availability: Author, Department of Health Education, P.O. Box 114, Teachers College, Columbia Univ., New York, N.Y. 10027

HS-019 078

AN HISTORICAL OVERVIEW OF RESEARCH IN TRAFFIC ACCIDENT INVESTIGATION ACTIVITIES

An updated overview of United States and foreign traffic accident investigation activities considers elements of investigation training, accident investigation team composition, report procedures and data compilation, use, and analysis, in areas of investigation technology including data methodology, accident prototypes, and evidence retention and reconstruction. The evolution of the highway accident problem as related to development of the automobile, the highway network, and relevant government agencies is traced from 1769 to 1975. Investigative techniques developed late during this period include: Multidisciplinary Accident Investigation (MDAI), Vehicle Deformation Index (VDI), Collision Deformation Classification (CDC), Abbreviated Injury Scale (AIS), Collision Performance and Injury Report (CPIR), NATO Collision Analysis Report (CAR), Automotive Crash Injury Research (ACIR), General Motors Accident Data Analysis Program (GM-ADAP), and Calspan Simulation Model for Automobile Collisions (SMAC). Methodology of reporting and procedures for quantifying and classifying data in these accident research systems are increasingly sophisticated in manipulating and analyzing data gathered. The SMAC program allows for computer reconstruction and analysis of traffic accidents using an ever growing data base. An accident investigation feasibility study sponsored by North Atlantic Treaty Organization/Organization for Economic Cooperation and Development is described as an attempt to establish accident investigation protocols as a common basis for traffic accident analysis on an international scale. The dynamic systems study has resulted in revision of the CAR form, new investigative methodology, and updating of automobile performance and deformation and injury severity

by Jack D. Baird; Eugene E. Flamboe
University of Southern California, Inst. of Safety and Systems Management
Rept. No. SAE-750891; 1975; 16p 19refs
Presented at the Automobile Engineering Meeting, Detroit, 13-17 Oct 1975.
Availability: SAE

HS-019 079

PAD WEAR INDICATION FOR DISC BRAKES

Pad wear indicators for disc brakes have been evaluated and compared for use in automobiles. A warning device actuated by the indicator can be used to notify the driver of excessive wear. All systems known as such indicators have been classified, described, evaluated, and compared. In the Volkswagenwerk the comparison favored selection of a newly developed system with which the wear of the pads is perceptively perceived and which is designated as the tactile indicator. The indicator works as follows: when the wear limit is reached, a wear resistant segment at the pad contacts a lug which is on the disc and is approximately the same size as the segment. This contact produces a perceptible knock at the brake pedal. The oscillations which arise produce inertia forces which are calculated. Furthermore, the wear resistance of the pad segment and the possible effects of oscillation on the braking ability of the vehicle before pads are replaced are calculated; braking ability is not adversely affected.

by Peter Hattwig
Volkswagenwerk AG, West Germany
Rept. No. SAE-750876; 1975; 19p 18refs
Presented at the Automobile Engineering Meeting, Detroit, 13-17 Oct 1975.
Availability: SAE

HS-019 080

NEUTRAL DENSITY PAINT MIXTURES PROVIDING PREDICTABLE DIFFUSE SURFACE REFLECTIVITY FOR VISIBILITY STUDIES

A method describing a reliable procedure for producing neutral density targets in automobile headlighting research is presented. Using adequate mixtures of white and black Nextel 3M paint the whole range of whiteness values was covered. With regard to the reflectance properties of the targets coated with these paint mixtures the following properties were observed: the luminance factors behave as a monotonic function of their whiteness; the functional dependence relating whiteness to luminance factors was essentially a function of the geometry used, nevertheless for normal incidence the targets behaved as uniform diffusers over a wide range of observation angles; for a given small angle between the directions of observation and of incident illumination, such as exists between the driver's line of sight and the illumination provided by his headlights, the luminous factor varied less than 7% over a plus or minus 30 degree variation in the orientation between the surface (target) and the direction of incidence. Therefore, in the case of three-dimensional targets such as those presently proposed for visibility experiments (Ref. 12), one can obtain a quasi-uniform brightness over the whole surface. The targets were also verified for spectral effects and were found to be essentially neutral in the visible range (400 to 750 nm). The

December 31, 1977

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above properties provide the basis to produce targets of predictable and dependable reflectance properties leading to direct data comparison and standardization of night visibility experiments between the various laboratories presently involved in headlight performance studies and visibility experiments. Fifteen graphs and 3 tables are presented to illustrate luminance behavior and factors as studied.

by A. A. Ayad
National Aeronautical Establishment, National Res. Council,
Canada
Rept. No. NRC-15291; 1976; 30p 12refs
Mechanical Engineering Report MS-137.
Availability: Corporate author

HS-019 082

MOTOR GASOLINES, WINTER 1975-76

Data for 2,699 samples of motor gasoline, from service stations throughout the country, were collected and analyzed under agreement between the Bartlesville Energy Research Center and the American Petroleum Institute. The samples represent the products of 56 companies, large and small, which manufacture and supply gasoline. These data are tabulated by groups according to brands (unlabeled) and grades for 17 marketing areas (districts) into which the country is divided. A map in this report shows marketing areas and sampling locations. The report also includes charts indicating the trends of selected properties of motor fuels since 1946 and three bar graphs illustrating the variations of octane numbers in the present survey by frequency for all samples represented. The averages for the antiknock (octane) index ((ROM)/2) of gasolines sold in this country were 88.2, 89.7, and 95.2 for unleaded, regular, and premium grades of gasolines, respectively.

by Ella Mae Shelton
Bartlesville Energy Res. Center, Bartlesville, Okla.
Rept. No. BERC/PPS-76/3; 1976; 76p 6refs
Published by ERDA at Bartlesville Energy Res. Center.
Availability: NTIS \$4.50

HS-019 083

THE ELECTROMAGNETIC SPECTRUM, A LIMITED RESOURCE, AND ITS MANAGEMENT

Much competition exists in the utilization of the electromagnetic spectrum as a natural resource. Guidance by regulatory agencies is seen as essential for most efficient utilization of the spectrum, with industry and user organizations providing inputs for the development of standards and noise limits. Such limits and standards must gain worldwide acceptance; for example, currently, Canadian and U.S. national committees concerned with electromagnetic interference compatibility are in disagreement with most other CISPR national committees on the need for limits of ignition noise above 250 MHz. Measuring equipment is diverse at a time when assessment of ignition interference should become standard. The amplitude probability distribution together with a mathematical model can be reconstructed from traditional measurements; field strength meters are available.

by H. de Witt
Department of Communications, Ottawa, Canada
Rept. No. SAE-760275; 1976; 7p 8refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 084

GOVERNOR'S HIGHWAY SAFETY ADMINISTRATION COMPREHENSIVE EMS (EMERGENCY MEDICAL SERVICE) PLAN: STATE OF WEST VIRGINIA

The 1974 Comprehensive Emergency Medical (EMS) Plan for West Virginia is organized through the West Virginia Governor's Highway Safety Administration to develop continuing programs, project cost estimates, and evaluate progress made in implementation of EMS in 11 planning and development regions. Training aspects responsibilities are placed with the State of Office of Comprehensive Health Planning. Eleven regional councils are also involved in EMS planning, development, and implementation. Legislation pertaining to the EMS system includes preparation of a model ordinance for passage in the near future, Good Samaritan Laws (1967), the Medical Practice Acts (1972), Licensing/Certification Laws (1974), the Driver's Licensing Advisory Board Law (1974), and the law allowing blood tests for alcohol in motor vehicle fatalities (1974). The status of EMS resources with regard to services, equipment, personnel, facilities, consumer education, evaluation, and patient flow pattern is reviewed, giving the number and types available by region. This information shows a total of 2,458 EMS technicians have been trained and certified, staffing facilities including emergency centers, major and limited emergency facilities, intensive care units, coronary care units, and related facilities. A particular problem noted is the trend toward funeral-home operators ceasing ambulance service, leaving some rural areas without organized access to EMS. The program area has two million population, predominantly middle-aged (25-54 years). Statistics for 1972 show nearly 19,000 motor vehicle accident injuries in the state, with 26.9 motor vehicular deaths per 100,000 population. Medical personnel besides EMS technicians number 1,792 active physicians and 13,553 active nurses. The areas covered are served preponderantly by local roads (nearly 80%) with only about 1,200 miles of major interstate and intrastate highways. Computer programming of accident data is expected to designate high accident locations by 1975. Geographic, climatic, and socioeconomic conditions through the state are generally poor for successful EMS systems operation, containing many areas of difficult weather, hazardous terrain, and high unemployment and poverty. Health-care deficiencies in these regions have been attributed to the lack of both primary care and EMS, with most deaths caused by severe illness such as heart and cerebrovascular diseases and neoplasms. EMS standards are stated for organization, operation, personnel training, ambulance specifications, distribution of response times, communications, and hospital facilities, emphasizing upgrading in personnel and facilities. Program objectives are outlined by priority, with provision made for identifying deficiencies and needs. Objectives are transportation, communications, training, facilities, consumer education and information, evaluation, updated planning, organization, management, standards development, and legislation. Methodology for program implementation is also discussed in terms of program content, scheduling, resources, commitment, and budget, emphasizing local involvement in all areas and coordination of EMS system operations. Evaluation of the EMS program will be continual, based on EMS data inventory and analysis from standardized report forms from all 11 regions. The major constraint for EMS in West Virginia is seen as the lack of ambulances and communication equipment in many areas, with the need for local in-

HS-019 085

volvement in EMS indicated as a necessity for implementation and improvement.

West Virginia State Office of Comprehensive Health Planning,
Charleston, W. Va.
Rept. No. HRP-0004730 ; 1974; 146p 1ref
Availability: NTIS

HS-019 085

DESIGN OF A FIRE PROOF VEHICLE

A Chevrolet Vega Notchback was modified by redesign and addition of fire safety devices to insure maximum fire safety for passengers, involving elements of the gas tank, fuel line and filler tube, absorption system, and circuit control system. A concave ends gas tank was added to allow containment of fuel under higher pressures up to 400 psi. Higher pressure fuel line and filler tube were relocated and attached so as to move with the gas tank in a collision, and a piston-valve device was put into the fuel line to prevent fuel entry at more than 30 psi. A honeycomb absorption system was installed in the rear section of the automobile to absorb impact energy up to 360 ft-lb per honeycomb unit. An integrated circuit control system was installed to detect fire and activate an extinguisher system containing Halon 1211 and Monnex. Component evaluation tests determined performance capability of the modifications and additions and determined their functional limits. Evaluation of the integrated circuit control system showed notable advantages in compactness, resistance to spark formation, and malfunction detection and warning reliability. Disadvantages of the fire control system are toxic decomposition products from the Halon extinguisher and ineffectiveness and bulk of the Monnex extinguisher. Improvement of extinguisher fillers, dynamic testing of the entire fire safety system, and consideration and testing of further fire safety related structural modifications are recommended. Experimental and design details for individual components are presented in appendices.

by Calvin Y-K. Chan; Lawrence L. Chi; Patrick J. Pagni
California Univ., Fire Res. Group, Berkeley, Calif.
Rept. No. UCB-FRG-75-18; NSF-RA-T-75-032; PB-246 740;
1975; 82p 10refs
Availability: NTIS

HS-019 086

THE BIG DEBATE OVER SYNTHETIC OILS FOR YOUR CAR

Proponents of both mineral oils and synthetic oils were interviewed concerning the characteristics and advantages of use of their respective products in automobiles. The development of synthetic oils is seen as a response to specific problems encountered in using mineral oils, such as viscosity changes with deleterious effects, corrosives production and results, and maintenance requirements for engines using mineral oils. Formulations of the synthetic engine oils include dibasic acid esters or diesters, polyol esters, polyalphaolefins (synthesized hydrocarbon), and alkylated benzenes (synthesized hydrocarbon). The synthetics were designed in response to specific engine problems, such as cold-weather starting and operating, high-heat operation such as in jet engines and highly accessorized automobiles, and proven instability of mineral oils, leading to deterioration and engine deposits of sludge, which result in engine wear and performance decrement. Current applications of synthetic oils are found especially in polar re-

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gions, jet engines, military vehicles, experimental vehicle and increasingly for public use. Early problems in development of synthetics (incompatibility with oil improvers, differential seal materials swelling, and changeover in a used engine) have been studied and solved with formulation design correction of additives, and proof of compatibility with mineral oils. Additional advantages claimed for using synthetic oils and lubricants include lower oil consumption, better temperature-extremes performance, better gas mileage, better engine performance, and longer interval between maintenance tasks due to less degradation and better suspension of particulates. While the advantages cited for synthetic oils and lubricants have been fairly well substantiated, varying levels of kinds of recommendations are developed for their use in current automobile engines. Future movement into more use of the synthetic oils and lubricants is predicted.

by C. P. Gilmore
Publ: Popular Science v208 n4 p90-9 (Apr 1976)
1976; 5refs
Availability: See publication

HS-019 087

FOAM-PADDED KSV: A SOFT APPROACH TO SMALL-CAR SAFETY

A new foam-padded kinetic safety vehicle (KSV) has been developed as an approach to improving small car safety. The purpose of using varying densities of foam in strategic locations inside the car is to provide an adequate crush zone yield a ride-down interval long enough to protect passengers the event of a collision. Conversion of stock subcompact automobiles to a modified version of the KSV requires replacement of exterior parts only, including conventional fender and front grille area, with the foam energy absorbing system. The stock KSV has additional front and rear crush zones built in. Static and crash test results were favorable. Lower repair costs for KSVs are also predicted. Estimates of additional production costs for incorporating the KSV design concept are seen as minimal in relation to the gains in safety.

by Jan P. Norbye
Publ: Popular Science v208 n4 p68-70 (May 1976)
1976
Availability: See publication

HS-019 088

ADVANCED STORAGE BATTERIES: PROGRESS, BUT NOT ELECTRIFYING

Advanced storage batteries are being developed for use in load leveling (providing power ten or more hours a day) and peak shaving (satisfying short-term power demands) for electric utility supply, and for powering electric vehicles with sufficient range and acceleration to be economically feasible for urban consumers. It is estimated that wide-scale use of such electric vehicles could save up to 25% of imported oil consumption and would also play a load-leveling role for utilities insofar as electricity for their use would be generated at night. Traditional lead-acid storage batteries have been unsuitable to sustain the deep discharge/charge cycles required for electric vehicles in inexpensive models, and the weight of such batteries in an electric vehicle would prohibit sufficient travel range. Researchers are now investigating electrochemical cells that operate at temperatures well above ambient (principally

minimum-sulfur and sodium-sulfate copolymers) to meet both cost and performance goals for utility load leveling, peak shaving, and electric vehicle propulsion. Storage batteries with a specific energy of 220 watt-hours per kilogram, a lifetime of five years, and a cost of \$20/kilowatt-hour could compete economically with present gas turbines at recent oil prices or with pumped hydroelectric storage for load leveling and peak shaving. In automobiles achieving this goal for specific energy would enable a driving range comparable to that of gasoline-powered cars, and a specific power of 220 watts per kilogram would allow a comparable acceleration. Some of these goals have been met in prototype cells, but some problems remain unsolved, such as finding a separator material which is inexpensive but effective in the highly corrosive cell environment. While large-scale electric vehicle development programs are being carried out in the U.S., Japan, and Great Britain, battery researchers state there is reason to believe that electric vehicles and batteries are still relatively imperfect and require the impetus of technological development and public demonstration projects before significant progress can be made. The provisions of the McCormack Bill (H.R. 8800) are reviewed with respect to near-term battery research and development, emphasizing the political balances and orientation of funding for the needed work.

by Arthur L. Robinson
Publ: Science v192 n4239 p541-3 (7 May 1976)
1976; 1ref
Availability: See publication

HS-019 089

THE NEW JERSEY MOTOR VEHICLE INSPECTION SYSTEM. A POSITION PAPER

The scope of the study was to examine available literature, analyze recommendations for modification of the vehicle inspection system made to date, and consider variables (such as cost factors and individual inspector-mechanics) and correlations between mechanical defects and accident rates. An overview of the inspection process in the state of New Jersey is given, tracing historically the use of inspection in conjunction with safety programs and outlining current inspection procedures and practices. A review of problems in the inspection system led to the recommendation of shortening the waiting times that are commonplace at many state inspection stations. A more long-range proposal is made to institute a systematic plan to permit the development of a more flexible and more efficient inspection program. The study concludes that since few automobile accidents are due to mechanical defects in automobiles and periodic inspection programs have not reduced the incidence of automobiles with mechanical defects anyway, the money for supporting such a program might better be applied to other areas of highway safety, such as to reducing the number of drunk drivers using the roads.

by Matthew J. Derham; Ralph F. Angelillo
AAA Automobile Clubs of New Jersey, Public Affairs Council
1975; 10p 5refs
Availability: Corporate author

THE GM SULFATE DISPERSION EXPERIMENT: REDUCING UNCERTAINTIES ABOUT THE CATALYTIC CONVERTER

Freeway conditions of 1985 were projectively created at the General Motors Proving Ground in a study of dispersion of sulfate emissions. Emissions were gathered from 352 catalyst-equipped cars and analysed for content. Instrumentation used in data collection and analysis included anemometers and sequential samplers, temperature sensors, and atmospheric research support instrumentation. Results indicate that catalyst sulfates were produced in smaller amounts and dispersed upward more readily than originally predicted by Environmental Protection Agency estimates. Experimental data gathered provide the basis for a better understanding of the physical and chemical nature of catalyst sulfates and will aid development of more realistic models of dispersion from roadways. The outcome has apparently aided in preventing the issuance of an EPA sulfate emission standard for 1979 models.

by Barbara Hildenbrand
General Motors Res. Labs., Warren, Mich. 48090
Publ: Search v11 n3 4p (May-Jun 1976)
1976; 3refs
Availability: Technical Information Dept., General Motors
Res. Labs. Warren, Mich. 48090

HS-019 091

AN EXPERIMENTAL ICE (INTERNAL COMBUSTION ENGINE)/BATTERY-ELECTRIC HYBRID WITH LOW EMISSIONS AND LOW FUEL CONSUMPTION CAPABILITY

An experimental internal combustion engine (ICE)/battery-electric hybrid automobile has been developed with low emissions and low fuel consumption capability. The automobile yielded emissions (gms/mi) less than 0.41 hydrocarbon, 3.40 carbon monoxide, and 1.0 nitric oxide as measured in a dynamotor test by the Environmental Protection Agency. Fuel economy increased by 50% on the hybrid in highway cycle tests with partial battery depletion. The 4,100 pound curb weight vehicle developed has a top speed over 70 mph, with acceleration rate of 0-60 mph in 16 seconds. Although low fuel consumption was not a goal in development of the vehicle, a requirement of 10 mpg was set in 1970 for the Federal Clean Car Incentive Program; a fuel economy of 30 mpg or more is projected for the hybrid automobile using known techniques for reducing fuel consumption. The hybrid automobile discussed features a small ICE and a dc dynamotor (generator/motor) on the same shaft to drive the vehicle through a conventional clutch and gears. Hydrocarbon and carbon monoxide emissions are reduced by a thermal reactor, and nitric oxide is also reduced. The ICE operates with a quasi-constant manifold vacuum. Analysis shows that in commuter applications, fuel economy can be increased 60% with partial battery depletion by hybridizing any conventional car. In a second car application, fuel economy can be increased 100% in comparison with conventional ICE vehicles of equal performance. It is concluded that the hybrid vehicle shows promise of saving large amounts of gasoline by shifting the base of vehicle drive energy from 100% limited-resource liquid

fuel to less petroleum and more plentiful coal and other electrical power producing energy sources.

by Victor Wouk
Petro-Electric Motors, Ltd.
Rept. No. SAE-760123; 1976; 28p 27refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 092

PERSONAL RAPID TRANSIT--HUMAN AND ENVIRONMENTAL SYNTHESIS

Design parameters of the Ford Motor Company's automatically controlled transportation (ACT) system from the viewpoint of passengers and from visual impact the system has on surrounding environment are reviewed. The ACT system now installed in the Fairlane Town Center in Dearborn, Michigan, and Bradley International Airport, Hartford, Connecticut, are presented as representation of a synthesis of proven technical disciplines to create a mode of transportation for effective, efficient people movement within a confined urban setting. The ACT features driverless computer-controlled vehicles with a long-life step-down chassis with interchangeable body configurations to transport either passengers or freight. The vehicle has a low profile of 9 feet (2.7m) in height, allowing it to penetrate existing or new buildings within a single story. It is 25 feet (7.6m) long by 6.5 feet (1.75m) wide, and weighs approximately 12,500 pounds empty. Internally the vehicle has a nominal capacity of 24 passengers and a crush load of up to 30 passengers. A superior spring suspension ride with minimum external noise is provided, and the electrically powered vehicle can cruise at 30 mph (48 kilometers/hour). Human factors to implement usage and environmental factors to allow aesthetic and operational coexistence of the system in an urban environment were considered in the design and development of ACT. It is concluded that the ACT system is a viable mode of travel for confined urban areas.

by W. H. Gollwitzer
Ford Motor Co.
Rept. No. SAE-760251; 1976; 8p
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 093

A CONSTRUCTION TRUCK FRONT TANDEM SUSPENSION WITH ONE DRIVING AXLE

Design requirements and solutions for a heavy-duty tandem steering axle suspension and the related special 8x6 construction truck chassis are described. By restricting the tandem axle load equalization to the maximum legal load range only, it was possible to design a suspension using individual axle mountings. This mounting achieved substantial benefits in weight, performance, cost, and development time over an equalizing beam type suspension as applied to a vehicle front end. In addition the design incorporates a variable front axle load distribution feature, which increases empty vehicle and off-highway mobility by allowing a temporary biasing of weight to the front driving axle. Consequently, the concept is particularly well suited to a front tandem with only one axle driving. Also described are experimental automatic control

variations, unsuccessful and otherwise, that led to the final development. Design simplicity and ease of part standardization with conventional production vehicles, allowing rapid model introduction, are emphasized.

by Robert W. Stieg
Mack Trucks, Inc.
Rept. No. SAE-760253; 1976; 16p
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 094

FRONT TANDEM TORSION BAR SUSPENSION FOR NON-DRIVING AXLES

A tandem front axle suspension using torsion bars as the suspension element has been developed in order to take advantage of the 1972 truck weight law in Quebec and Ontario, Canada, allowing 80,000 pounds and 76,000 pounds GVW divided evenly on four axles. To steer the axles, dual integral power steering gears were chosen. The suspension has been in production for three years and approximately 150 units have been built for a limited market. The suspension has demonstrated advantages in load compensation, service life, tire life, and maintenance cost. Problems encountered involve hard ride and lateral sway. Means of dealing with these problems are suggested through design changes, principally that of sizing of the torsion bars.

by Svein Ellingsen
Kenworth Truck Co.
Rept. No. SAE-760254; 1976; 8p 1ref
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 095

LIGHTWEIGHT BRAKE SYSTEM

A light weight hydraulic disc brake system, featuring several innovations in design, has been developed for on highway, recreational vehicle use. The system uses aluminum components for the major structural members of the brake and master cylinder. A plastic master cylinder piston is used. The brake system uses a stamped steel rotor and metallic friction materials. The components of the system have passed life cycle, environmental, and vibration tests, which were based on Kelsey-Hayes test requirements for the automotive industry. The system is determined to be ready for high performance light weight applications.

by Jere S. Culp
Kelsey Hayes Co.
Rept. No. SAE-760255; 1976; 8p
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 096

TWIN DISC BRAKE ROTOR

Design and development testing of a twin disc brake rotor are described. Objectives of the development program were stated as stamping of rotor from flat rolled steel, compatibility of

rotor with an existing system, improved performance relating to new safety standards, simplicity in fabrication, and longer life expectancy. The basic concept of the rotor developed is the use of the inside surface of rotor faces as well as the outer. The novel design feature involves replacement of fins of a conventional brake rotor by a double-faced pad which doubles the lining area without modification of the caliper, wheel, or other hardware. After a total of 14,500 miles of use on a prototype vehicle, the new brake rotor design showed superior performance and presented a good feel to the driver. This improvement in energy absorption for a given pedal effort or line pressure could be translated into cost or weight reductions when baseline performance is adequate. No stamped parts were made but the shapes used were designed to be stampable from conventional sheet steels. Although the rotor designed was compatible with an existing brake system, the result was not optimal. The rotor designed is simply fabricated and does not require welding or complex mechanical fastening means. Lining life expectancy was not evaluated but could be considered as extended since the lining area was doubled.

by Robert S. McKee; Robert E. Luetje
McKee Engineering; Armco Steel Corp.
Rept. No. SAE-760257; 1976; 8p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 097

THE PHENOLIC DISC BRAKE PISTON

Various stages of design, test, and process that led to the selection of a non-metallic material for the disc brake piston are described. The combined efforts of the material supplier, molder, and end user made it possible to screen and formulate a material for this application, establish a design, and select a process that would produce pistons to meet disc brake functional requirements. The result of the material and design development program is the unique use of a non-metallic thermoset material as a molded phenolic disc brake piston, released as an alternative to the chrome-plated steel piston on 1975 Chrysler, Plymouth, Dodge, and Imperial automobiles. The design permits the use, interchangeably with the plated steel piston, without changes to caliper bore, seal, shoe, and lining, or the boot. Material properties of the phenolic compound and results of disc brake bond tolerance and follow brake system tests are included. Advantages of the material developed will lead to other applications requiring resistance to high temperatures and dimensional stability.

by J. M. Knoll; J. E. Emmett
Chrysler Corp.; Durez Div.-Hooker Chemical
Rept. No. SAE-760258; 1976; 8p 2refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 098

ARE LIGHTWEIGHT, ECONOMIC SMC (SHEET MOLDING COMPOUND) BUMPERS JUST A DREAM?

The new oriented roving sheet molding compound (SMC) material system is described and compared with conventional and continuous roving SMC for application in lightweight, economic bumpers. Bumper impact sled test procedures and parameters are explained, and results are compared among the

different SMCs, steel, and aluminum. The tests showed that resulting total impact forces through the bumper supports into the chassis frame were lower for SMC bumpers (less than 1/3 that for steel), deflection for steel and aluminum bumpers was lower (approximately 1/4 that for SMC), energy absorption prior to permanent deformation was higher for SMC bumpers (10-16% higher than steel and aluminum), and respective accelerations/decelerations were much lower for SMC bumpers fixed mounted (about half). Design proposals for SMC bumpers include open profile, three-piece, integral (closed profile), corrugated panels, and combination with shock absorbers. Criteria influencing the growth in use of SMC bumpers in the future include weight and cost considerations; styling demands; engineering ingenuity; and safety factors. While European passenger cars are already being equipped with SMC bumpers, the new, high-strength SMC material system has been introduced to expand further use of SMC in this area. The conclusion is that SMC absorbs and stores a high amount of energy and offers numerous advantages over use of conventional bumper materials, indicating expanded future applications.

by Peter Peterson
Owens-Corning Fiberglass Europe S.A. (Belgium)
Rept. No. SAE-760259; 1976; 14p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 099

FACTORS AFFECTING PLASTIC FOR HIGH-VOLUME EXTERIOR AUTOMOTIVE APPLICATIONS

Factors affecting plastic for high-volume exterior automotive applications are examined. In the average American automobile plastic exterior part applications account for approximately 20 pounds of a total of 160 pounds of plastic used in the total automobile. The current applications of plastic are seen because the advantages of using plastic offsets risks of utilizing a new material. The outlook for increased use of plastics on automobile exteriors is considered in relation to a combination of factors within both automotive and plastics industries. These factors involve advantages, product application issues, and other considerations. Advantages of using plastics are cost savings, reduction in complexity, unique styling or feature value, unique functional requirements, low tooling costs, product weight savings, and corrosion protection. Issues of application include the need for special assembly plant processing and handling, performance and durability requirements, safety and damageability considerations, serviceability and repair parameters, surface appearance, material and processing costs, and investment requirements and constraints. Other considerations include special material selection decisions, such as materials availability and potential shortages, energy consumption for processing and manufacture, scrap recycling, and federal and state legislation. An assessment of these factors has led to the conclusion that use of plastics in automobile exteriors as well as interiors will rapidly expand.

by Louis J. Chmura
Ford Motor Co., Engineering and Res. Staff
Rept. No. SAE-760260; 1976; 8p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 100

HS-019 100

THE NEW TRADE-OFFS IN ENGINEERING MATERIALS SELECTION

Three emerging issues which currently affect material selection decisions throughout the world are outlined: ecology, increasing government regulations and consumerism, and the energy shortage. An analysis regarding the need for automotive weight reduction and the concomitant effects of weight reduction on fuel economy as related to these issues is presented. Ecological factors have forced material selectors to look beyond the immediate realm of a particular material to a broader ecosystem in terms of both consumption of natural resources and burdens placed on the environment. Increasing government regulations proliferated by agencies created in response to consumerism give rise to other material selection and use factors considering health and safety hazards as well as economy. The energy efficiency of alternative products is considered in terms of energy content of the materials, energy consumed in producing parts, type of energy used, and energy consumed in use of the final product. In the case of automobiles it has been shown that there is an inverse relationship between gas mileage and weight, so that over a 70,000 mile life of a car, each 100 pounds in weight saved means 100 to 150 gallons of gasoline saved. Consideration of all the trade-offs in engineering design and materials selection can pay off in substantial energy savings without compromising safety requirements.

by Edward K. Gray; Roy W. McLeefe
Plastics Dept., E. I. du Pont de Nemours and Co., Inc.
Rept. No. SAE-760263; 1976; 8p 2refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 101

THE PERFORMANCE OF A MULTIGAP SPARK PLUG DESIGNED FOR AUTOMOTIVE APPLICATIONS

The electrical principle of operation, the geometrical and electrical circuit constraints on the design of, and the electrical and in-engine performance of a multigap spark plug developed for automotive applications are described. The electrical principle of operation is based on successively breaking down an array of spark gaps through the use of a resistive ladder network. The measurements evaluating the electrical performance of various multigap designs indicate that these plugs can deliver up to twice the energy of a single gap plug to the arcs, using the same ignition system. The increased amount of energy is also delivered in a shorter time than for single gap plugs. The measurements evaluating the in-engine performance of these plugs further indicate that improvements of up to 6% in fuel economy for a simulated CVS test run, the extension of the lean misfire limit by several air/fuel ratio numbers under various engine operating conditions, and improvements in driveability can be achieved compared to the performance of standard plugs under the same operating conditions.

by W. G. Rado; J. E. Amey; B. Bates; A. H. Turner
Ford Motor Co.
Rept. No. SAE-760264; 1976; 16p 1ref
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HSL 2

HS-019 102

DIGITAL ELECTRONIC SPARK ADVANCE SYSTEMS

Three digital spark advance systems presented are: (A) special-purpose computer with integrated data memory; (B) special-purpose computer with separate data memory accessible for other systems; and (C) special-purpose computer with memory. These systems offer improvements such as faster parameters controlling advance characteristic in addition to speed and load (e.g. temperature), higher complexity advance curves, no changes in timing due to wear of mechanical parts of the advance mechanism, and increased accuracy in timing by pick-up at flywheel. Systems A and B use Read Only Memory (ROM) signal processing units, which store spark timing characteristics vs speed and load. System C requires signals from speed, reference mark, and load sensor. Values specific to the vehicle are stored in the ROM and can be changed using mask programming. System B differs from A in the way speed is determined (angular sensor), organization of the memory (allows access for other digital systems), computer structure (by-pass provided to allow emergency operation of vehicle). System C operates without microcomputer with all functions specified by wiring, and formation of advance characteristic through logical linkage of computer components and/or design of corresponding increment sensor. Comparison of the systems shows A is highly accurate and easily fitted to different motors with advance characteristic by ROM, integrated into other systems using the ROM unit to program advance characteristic; C has advance characteristic by microcomputer design and only medium accuracy.

by Hansjoerg Manger
Robert Bosch G.m.b.H, West Germany
Rept. No. SAE-760265; 1976; 13p 3refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 103

THE FERRORESONANT CAPACITOR DISCHARGE IGNITION (FCDI) SYSTEM: A MULTIPLE FIRING CAPACITOR DISCHARGE IGNITION WITH SPARK DISCHARGE SUSTAINING BETWEEN FIRINGS

An experimental programmable ignition system based on a new principle of operation, the ferroresonant capacitor discharge ignition (FCDI) system, is described. The ignition system features multiple firing with spark discharge sustaining between firings. It provides for electronically controlled changes in spark duration, spark current level, and resonance rate, and combines a fast rise time with a controlled duration. Extensive multicylinder engine dynamometer tests data are presented which indicate that improved ignition can be achieved at marginal engine operating points. Results also indicate progress toward improving fuel economy and minimizing emission control requirements through the efficiency of the ignition system.

by Joseph R. Asik; Bradford Bates
Ford Motor Co., Engineering and Res. Staff
Rept. No. SAE-760266; 1976; 20p 11refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

-019 104

EVALUATION OF A BUTADIENE-STYRENE VISCOSITY INDEX IMPROVER

Qualitative laboratory and field test data are presented on multigrade motor oils formulated with a new viscosity index (VI) improver developed by Phillips Petroleum Company. This VI improver is a hydrogenated copolymer of butadiene and styrene. Its unique features are outstanding shear and oxidation stability and excellent performance in Caterpillar 1-H diesel tests. Attention is focused not only on these features but also on its overall performance in multigraded oils. Although this VI improver was originally developed for passenger-car multigrade oils, data are present to justify application in truck multigrade oils, high VI hydraulic oils, automatic transmission fluids, farm tractor hydraulic fluids, and use as a improver and thickener in several synthetic oils. Five major areas of performance of the VI improver were evaluated in laboratory studies, including blending characteristics in mineral bases, permanent and temporary shear stability, low temperature flow, ASTM sequence and MIL-L-46152 engine tests, and European CCMC engine tests. Field testing investigated performance parameters such as engine cleanliness, wear, air stability, octane requirement level-out, oil economy, and oil thickening. It is concluded that this hydrogenated butadiene-styrene copolymer compound is a well balanced VI improver for applications in many types of lubricant formulations.

W. L. Streets; K. H. Yochum; Bill Mitacek
Phillips Petroleum Co.
Rept. No. SAE-760267; 1976; 20p 11refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

-019 105

CRANKING AND PUMPABILITY CHARACTERISTICS OF MULTIGRADE MINERAL AND SYNTHETIC ENGINE OILS

Hot and cold engine cranking performances of seven multigrade synthetic engine oils are compared to those of one multigrade and four single-grade mineral oils. In addition, the low-temperature pumpability characteristics of these oils are compared. Data obtained on borderline pumping temperatures, the cold cranking torque requirements, and the maximum hot cranking torque requirements are presented. These data show that an experimental synthetic hydrocarbon blend containing an oiliness agent exhibited better low temperature characteristics than the SAE 10W mineral oil and achieved a lower maximum hot cranking torque requirement than the SAE 40 mineral oil. The addition of an oiliness agent to an experimental synthetic oil reduces its hot cranking torque requirements substantially. Both commercial synthetic engine oils and the commercial 10W/40 mineral oil evaluated required higher hot cranking torques at low speed than the SAE 40 mineral reference oil. All of the synthetic oils evaluated except one exhibited better low-temperature characteristics than the SAE V mineral oil. Results indicate that a synthetic engine oil can be formulated which is superior to current mineral oils under both high and low temperature conditions.

C. R. Spohn; R. M. Stewart
Res. and Devel. Co.
Rept. No. SAE-760268; 1976; 12p 5refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 106

THE EFFECT OF POLYMERS IN MULTIGRADE LUBRICATING OILS ON ENGINE WEAR

Parameters affecting the wear protecting properties of polymers in multigrade oils have been investigated. The parameters discussed include concentration, molecular weight, and solubility properties. Road and engine tests were carried out to assess the effect of such polymers in multigrade lubricating oils on engine wear. Oils containing polymethacrylate were tested in connection with connecting rod bearing, front sealing, cam rig, cylinder, and skew gear wear in a variety of automobile makes. It is shown that the polymethacrylate additive contributed to the wear protecting properties of multigrade oils in the test environment provided sufficiently high concentrations were used. Polymers of different chemistry were also tested, including dispersant type polymethacrylates, ethylene-propylene, and diene-styrene copolymers in combination with conventional oil compounds. Bearing and cam wear tests showed that the lowest wear rate was measured with use of the oil containing the highest polymer dosage. Mechanisms for accomplishment of these protecting results are suggested. Results indicate that the main parameter affecting the wear protecting properties of polymers in multigrade oils is polymer content, disregarding the chemistry of the polymer.

by P. Neudorfl
Roehm G.m.b.H, Germany
Rept. No. SAE-760269; 1976; 12p 12refs
Presented at the Automotive Engineering Congress and Exposition, 23-27 Feb 1976.
Availability: SAE

HS-019 107

FIELD PERFORMANCE OF DIESEL ENGINE OILS

As a result of diesel engine failures being experienced in the field with approved engine oils, an extensive truck field test has been carried out using over 40 different oil formulations ranging in quality from CA to CD/SE/1% ash in four major types of diesel engines. Results show that fire-ring sticking is the major problem with a trunk piston 2-cycle engine, and this appears to be related to the additive composition rather than the oil classification level. An examination of the groove deposits shows that ring sticking is the result of rapid ash build-up in the fire-ring groove under severe operating conditions. A crosshead piston/keystone ring combination has eliminated the ring sticking problem with this engine even though the two piston types build up similar deposit levels. A 10W/30 multigrade oil gives excellent performance in the crosshead piston 2-cycle engine. A major type of four-cycle engine gives satisfactory performance with oils ranging in quality from CC/SC to CD/SE, although the higher dispersant SE quality oils do give lower groove fill and cleaner overall engine condition. The 10W/30 multigrade oil gives excellent performance in this engine and even shows a benefit with regard to decreasing bearing wear. Two further types of four-cycle engines have been shown to give excellent performance with a Universal oil and with a 10W/30 multigrade oil using 16-18 thousand mile oil change intervals. It is concluded that the ring sticking problem is a function of oil additive type. Recom-

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recommendations are indicated for selection of engine oils and for change intervals.

by R. Overton; D. E. Steere; L. R. Carey
Imperial Oil Enterprises, Ltd.
Rept. No. SAE-760270; 1976; 16p 14refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 108

THE EFFECT OF POLYMER TYPE UPON PERFORMANCE OF MULTIGRADE OILS IN PETROL AND DIESEL ENGINES

Three main viscosity index improvers for multigrade engine oils (polyalkyl-methacrylate, ethylene-propylene-copolymer, and diene-styrene-copolymer) were compared with respect to their effect on performance of multigrade oils in petrol and diesel engines. Parameters studied included viscosity-temperature relationship, viscosity as a function of shear stress and thermal oxidation, wear protection, and deposit formation. Results of the comparison tests showed considerable differences in polymer effect. Beneficial properties in one area of performance do not necessarily indicate satisfactory performance in other areas, indicating the incompatibility of requirements for performance with reference to capabilities of currently available oils. In particular the selection of different polymers to get the desired performance in diesel or petrol engine lubricants contraindicates the belief in feasible development of a universal oil formulation. Besides the treating needs of the two kinds of engine, a requirement for future formulations is the consideration of treating cost in relation to optimal performance needs.

by U. Schodel
Roehm G.m.b.H, Germany
Rept. No. SAE-760271; 1976; 12p 32refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 109

NEEDED: A SYSTEMS APPROACH TO ELECTROMAGNETIC COMPATIBILITY

An approach toward protecting vital radio services from unacceptable degradation of performance caused by incidental radiation emanating from devices designed for other purposes (such as motor vehicles, cigarette lighters, calculators, light dimmers, and aquarium heaters) is presented. Incidental radiation from motor vehicles is discussed in two kinds: impulsive vehicle emissions affecting on-board equipment and vehicle radiation affecting external receivers. Although the potential of these devices for creating interference is not recognized by many manufacturers, manufacturers who have recognized the problem have a difficult task in surmounting it due to the diverse products involved, marketing, scope of utilization, and lack of regulation. The Federal Communications Commission is aware of the situation and is planning an evaluation of alternatives available to obtain the desired effect or reduction of undesirable interference. It is proposed that the problem be considered on a systems basis and controls applied in a method providing maximum benefit for costs incurred. Alternatives range from controlling incidental radiation emissions to

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development of receiver circuitry to minimize the radiated effects. The goal of electromagnetic compatibility is stated to emphasize the notion that interference studies and regulations can best consider solving the problem through a systems approach rather than through component reform. Criteria for regulation include analysis of principal and secondary costs, comparison of expected costs with costs, and a review of alternatives to the proposed action.

by A. C. Doty, Jr.
Motor Vehicle Manufacturers Assoc. of the United States, Inc.
Rept. No. SAE-760272; 1976; 8p 18refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 110

ELECTROMAGNETIC INTERFERENCE (EMI) MEASUREMENTS FOR AUTOMOTIVE APPLICATIONS

Presently used electromagnetic interference (EMI) measurement techniques determine one or more of five basic parameters: electric field strength; magnetic field strength; voltage; current; and power. Under special conditions, if the parameter is stable, these parameters can be measured accurately. However, in common EMI measurements, these parameters vary 50 to 100 dB with time, frequency, orientation, and position. It is suggested that new techniques are needed in measurement to accommodate and quantify these variations. Present measurement techniques have the disadvantages of requiring free space testing, shielded enclosure, influencing radiation characteristics by nature of the enclosure, and standardization of display systems, all leading to limitations in measurement capability and distortion of interference measurements. Improved measurement techniques are introduced: broad band probes of either passive (dipoles with high impedance transmission line) or active (antennas to detect, amplify, and transmit detected interference) type, capable of measuring complex interference fields with minimum perturbation; the transverse electromagnetic (TEM) transmission cell, allowing absolute determination of test fields and their interaction with equipment under test; and isotropic probes capable of measuring unperturbed, complex fields close to source. Efforts are being made to extend the TEM cell technique in three areas: optimization of interference parameters, use of timed cells for exposure chambers, evaluation of small components, and transient response analysis. Some suggestions for minimizing automotive EMI problems are given concerning management of harnesses and wires interconnecting electronic packages, shielding, filters, and systems analysis of the electrical system used in particular automobile models. Cost-effective improvements are needed.

by J. W. Adams; M. L. Crawford; J. F. Shafer
National Bureau of Standards, Washington, D.C.
Rept. No. SAE-760273; 1976; 8p 9refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-019 111

ENGINE PERFORMANCE TEST OF THE 1975 GM 140-CID. INTERIM REPORT

An engine test of the 1975 GM 140 cubic-inch-displacement, four cylinder engine was performed to determine its steady-state fuel consumption and emissions maps over the entire operating range of the engine. The engine was mounted on a test stand and connected to a dynamometer, with emission control systems including exhaust gas recirculation (EGR), evaporative control charcoal canister, high energy ignition system, and catalytic oxidation system. Exhaust data were collected before and after the catalyst, and emission rates were computed for the catalyst and noncatalyst systems. Results show maintenance of lean air/fuel mixtures over a wide range in speed and load with significant enrichment only at wide-open-throttle (WOT) modes and effective catalyst oxidation of carbon monoxide and unburned hydrocarbons at conditions other than WOT. High EGR rates and catalyst oxidation produced overall low levels of oxides of nitrogen emissions. Test data are presented in tabular and graphical formats.

by W. F. Marshall; K. R. Stamper
Energy Res. and Devel. Administration, Bartlesville Energy Res. Center, P.O. Box 1398, Bartlesville, Okla. 74003
Contract RA-75-10
Rept. No. DOT-TSC-OST-76-22; 1976; 31p
Rept. for Aug-Sep 1975.
Availability: NTIS

HS-019 112

STUDY OF AERODYNAMIC DRAG REDUCTION ON A FULL-SCALE TRACTOR-TRAILER. FINAL REPORT

Aerodynamic drag tests were performed on a tractor-trailer combination using the coast-down method on a smooth, nearly level runway. The tests included an investigation of drag reduction obtained with add-on devices that are commercially available or under development. The tests covered tractor-trailer speeds ranging from approximately 35 to 65 miles per hour and included fuel consumption measurements. The study shows the effects of the various add-on devices on the aerodynamic drag, and for some devices on the fuel consumption. Results from a simulation of fuel consumption tests using a computer program are also included. Conclusions derived from the study are given: the maximum fuel savings realized were about 10% for devices A and E (cab mounted wind baffles) when exposed to calm or near calm wind conditions. The maximum aerodynamic drag reduction realized with an add-on device at zero wind conditions was approximately 24% for the rear trailer position. Limited coast-down data obtained with some of the devices tested showed that their ability to decrease drag was reduced by the presence of crosswinds, a result confirmed in a qualitative sense by results from fuel consumption tests made during windy conditions. Simulation of aerodynamic drag reductions of 20 to 24% produced fuel consumption reduction of 10.9 to 13.5%, respectively, for a 32,500 pound vehicle. Simulation of a fully loaded 70,000 pound vehicle for the same drag reductions showed fuel consumption reductions ranging from 9.0 to 10.8 percent. Reducing the cab-to-trailer gap distance in mounting the devices decreased the aerodynamic drag of the baseline configuration at zero wind conditions to a total drag reduction of about 7 percent. Recommendations made for further testing include

testing of devices A and E on conventional tractor-trailer combinations with consideration of effects of crosswinds.

by L. L. Steers; L. C. Montoya
National Aeronautics and Space Administration, Dryden Flight Res. Center, P. O. Box 273, Edwards, Calif. 93523
Contract RA-74-31
Rept. No. DOT-TSC-OST-76-13; 1976; 59p 17refs
Report for Mar-Dec 1974.
Availability: NTIS

HS-019 113

ONTARIO'S BUCKLE-UP LAW IS PAYING OFF. FIRST QUARTER ACCIDENT STATISTICS SHOW DRAMATIC REDUCTION IN FATALITIES AND INJURIES

The number of drivers and passengers killed in the first implementation quarter was 33.6% lower than the number killed in the corresponding period in 1975, and injuries declined 18.7%. The history of the legislation and the campaign for its implementation are reviewed, showing stiff opposition initially to the law and subsequent acceptance and support. Early in the campaign of enforcement, noncompliant motorists were cautioned or warned; strict enforcement of the law soon followed. Educational material and publicity for the new law and its intended effects for motorists' protection were described, emphasizing positive results of the use of seat belts in specific accident situations. Provisions of the law require that if a vehicle is/was equipped with seat belts or shoulder harnesses at the time of manufacture, then that assembly must be used by the driver at all times and by passengers seated in equipped spaces. Each adult is held responsible for himself, with exceptions made for driver in reverse, delivery personnel, and medical cases. Additional provisions excepted: children under the age of five or weighing less than 50 pounds (due to availability of child safety seat units); optional shoulder harness usage for cars equipped pre-1974 (due to difficulties in proper adjustment); and cab drivers (for personal safety in the event of attack or armed robbery). Mandatory safety belt laws are advocated for adoption in other regions because of the impressive statistics in saving human life and preventing injury.

by P. G. Green
Publ: Traffic Safety v76 n7 p8-11, 34-5 (Jul 1976)
1976
Availability: See publication

HS-019 114

RIGHT TURN ON RED: UTILIZATION AND IMPACT. FINAL REPORT

An investigation of the quality of use of "right turn on red" (RTOR) in Indiana after one year of allowing the traffic maneuver as a basic rule was carried out. Attention was given to studying all factors that might affect the maneuver as well as the consequences that might occur as a result of applying it. Data were obtained from 150 signalized intersection approaches scattered in 18 cities. Each approach was observed for four hours during peak and off-peak periods. The study examined the performance of the RTOR maneuver and the effect of the maneuver on traffic conflicts as well as pedestrians. A part of the study examined left turn on red (LTOR) from a one-way street to another one-way street. The number of vehicles that turned on red at locations where RTOR or LTOR

and recommendations regarding the practice of turning on red in their cities. Results show that RTOR was made by 19.5% of the total right turns, while the LTOR was made by only 1.3% of the total left turns. The number of violations at locations where the turn on red movements were prohibited was very small and certainly insignificant. Important factors that affected RTOR usage were signal type, city size, and availability of exclusive right turn lanes. The number of approach lanes and the number of cross lanes were of little importance. Conflicts between turning on red vehicles and cross traffic did not cause a significant problem. Also, turning on red vehicles did not cause significant hazard to pedestrians. Twenty RTOR accidents were reported in one year in over 70 cities according to questionnaire answers and interviews with traffic engineers. These accidents involved only minor property damages and minor injuries. Most traffic officials surveyed were in favor of allowing the RTOR maneuver as a basic rule. The only consistent problem reported was that some drivers turn on red without coming to a complete stop before turning. Locations from which the data for evaluation were collected and the questionnaire on RTOR with cities replying listed are contained in appendixes A and B. The statistical analysis of data is presented in Appendix C.

by Michael S. Mamlouk
Purdue Univ., Joint Hwy. Res. Proj., Engineering Experiment Station, West Lafayette, Ind.
Rept. No. JHRP-76-17; 1976; 112p 29refs
Prepared in cooperation with Indiana State Hwy. Commission.
Availability: Corporate author

HS-019 115

CHARACTERISTICS OF HEAVY TRUCK ACCIDENTS. FINAL REPORT

A research project has determined accident rates for heavy trucks on rural Interstate and primary highways in Indiana for 1974 and the first half of 1975 under the 55 mph maximum speed limit and for 1970-1972 under the 70 mph and 65 mph limits. Another purpose was to determine the characteristics of heavy truck accidents on rural Interstate and primary highways for the same periods, evaluating heavy truck accident involvements for the same classes of highways during the same time periods. An evaluation was also made of the effect on accident rates of the condition where all vehicles are travelling at nearly the same speed. Twenty-four Interstate, 26 other four-lane, and 75 two-lane highway sections were used for the study. The exact length of each study section was measured, and traffic volumes for all study sections during the study time periods were calculated by using data of a 1972 ADT map together with suitable conversion factors. The total number of truck accidents and number of accidents by type were collected from accident reports for each of the study sections for the years studied. The 11-station special loadometer survey of the Indiana State Highway Commission for each year of the study periods was used to calculate average percentages of heavy trucks on study sections. Average truck accident rates decreased significantly on Interstate and other four-lane highways, but the reduction in average rates was not significant on two-lane highways under the 55 mph speed limit as compared with data from before the 55 mph limit. Decreases in average rear-end collision truck accident rates were significant only on Interstate and on other four-lane roads. Changes in average rates of ran-off-road and side-swipe

passenger car accident rates decreased significantly on Interstate roads under the new limit but trucks rates remained greater than car rates. There is some indication that trucks were more involved than passenger cars on other four-lane and lane highways since the 55 mph limit. The increase in ratio between truck and passenger car accident rates on these roads was not considered significant. On two-lane highways passenger car and truck accident rates were similar under the 55 mph limit, reflecting a drop in accident rates for cars under the 65 mph limit. The increase in ratio between truck and passenger car accident rates was considered significant for Interstate highway class. Significant decreases in accidents by trucks and cars during the years studied are associated with the 55 mph limit. Characteristics of trucks are considered in structuring the conclusions reached about accident rates and road usage practices. These characteristics (weight, size, acceleration, deceleration, use design, damage costs, injury severity, operation and maintenance costs, and standardization) offer a basic pattern of different use, performance, and cost-effectiveness which may relate to high accident rates in direct comparison of these parameters with their relevant presence in passenger cars.

by A. E. S. Radwan
Joint Hwy. Res. Proj., Engineering Experiment Station, Purdue Univ., West Lafayette, Ind.
Rept. No. JHRP-76-18; 1976; 127p 28refs
Prepared in cooperation with Indiana State Hwy. Commission.
Availability: Corporate author

HS-019 116

TRAFFIC SPEED REPORT NO. 96

A report on observations of spot speeds of free-flowing traffic on level tangent sections of rural and urban Indiana highways is presented. The spot speeds were observed on Interstate, four-lane, and two-lane highways throughout the state during the months of February and March 1976. Observations for this study were taken by use of an electromagnetic speed meter. Analysis of the speeds observed showed that the overall average speed for all vehicles was 56.8 mph. The overall average speed for passenger cars and all trucks was 57.3 mph and 55.6 mph, respectively. These overall average speeds are 0.6 mph, 0.5 mph, and 0.7 mph less for all vehicles, passenger cars, and all trucks, respectively, as compared with data collected in the same manner in October-November 1975. Results indicate a reduction in average speeds and 85th percentile speeds occurred mainly on two-lane highways. On four-lane highways a slight decrease occurred for average speeds and the 85th percentile speeds. A slight increase occurred for average speeds and the 85th percentile speeds on Interstate highways. Speed data collected are presented in tables in Appendix A, and summarized per Federal Highway Administration format for quarterly speed monitoring in Appendix B.

by A. A. Gadallah; G. K. Stafford
Purdue Univ., Joint Hwy. Res. Proj., Civil Engineering Building, West Lafayette, Ind. 47907
Contract HPR-1(13)-Part I
Rept. No. JHRP-76-20; 1976; 31p
Interim report for Jan-Mar 1976, on "Speed Trends for Indiana Highways." Conducted in cooperation with the Federal Highway Administration and the Indiana State Hwy. Commission. See also report no. 95, HS-018 677.
Availability: NTIS

December 31, 1977

HS-019 119

HS-019 117

PROBLEMS OF INSTRUMENTATION IN CAR-FOLLOWING RESEARCH

Findings of an investigation into development of techniques and instrumentation to study following behavior or car-following in motor vehicle drivers unaware of observation are reported. Documentation research was carried out and operating requirements were drawn up specifying the performance of such instrumentation, but without success. The attempted instrumentation used Doppler radar to measure relative movements of vehicles. Findings indicated that cost of development and use of the radar equipment specified was prohibitive, and that intrinsic interferences in the normal traffic environment would negate results in terms of range of measurements and operating distances and of accuracy. In addition, interfering measurements due to other than longitudinal motions of vehicles studied are predicted, as well as interfering motion occurring in the radar equipped vehicle. Reflections from environmental surfaces and other traffic, road irregularities and configurations, and weather conditions also present interference problems for the radar system designed. Nevertheless the project showed ways of further studying possibilities of reducing irregularities in motor vehicle following behavior relating to the perception of intrinsic danger, traffic volume and gap maintenance, and the relationship between traffic volume and speed. An analysis of the driving task in terms of driver perception and information processing was also performed.

Institute for Road Safety Res., SWOV, Deernsstraat 1, P.O. Box 71, Voorburg 2119, The Netherlands
1974; 30p 10refs
Availability: Corporate author

HS-019 118

URBAN MASS TRANSPORTATION ACT OF 1964 AND RELATED LAWS, AS AMENDED THROUGH FEBRUARY 5, 1976

Statutes authorizing and governing the Federal urban mass transportation program and the Urban Mass Transportation Administration (UMTA), as well as other statutory material relevant to mass transportation and government operations are presented. Contents include the Urban Mass Transportation Act of 1964, as amended through February 5, 1976 (the Act); related material from the Urban Mass Transportation Act of 1970; related material from the National Mass Transportation Assistance Act of 1974; Federal-aid highway laws relevant to the UMTA program; and a selection of statutory materials relevant to both substantive aspects of UMTA programs and administrative operations of the agency. The Urban Mass Transportation Act of 1964 as amended provides for research and development of urban transportation systems by means of Federal financial assistance levels and authority are described for programs of planning, development, and operation of urban transportation systems and facilities; technical studies; managerial training programs; research and training in urban transportation problems; labor standards; environmental protection; special needs of the elderly and handicapped; emergency operating assistance; and increased mass transportation assistance (fare support). Federal aid highway laws relating to mass transportation are presented to illuminate the policy of Federal aid systems with regard to share financing, correlation of transportation planning, urban area traffic operations improvement, fringe and corridor parking facilities, public trans-

portation, priority primary routes, and allocation of urban system funds. General provisions for authority and governance of the Federal highway system in relation to urban mass transportation systems are given with regard to tolls, small business enterprises, state highway departments, administration organization, research and planning, and cooperation with Federal and state agencies and foreign countries. Excerpts from the Federal-Aid Highway Act of 1973 are presented as funding and policy sources for public mass transportation studies, Metro accessibility to the handicapped, high-speed transportation demonstration, rural highway public transportation demonstration, bus and other project standards, research and planning, and financial assistance agreements. Other materials presented relate to the UMTA or mass transportation in general with provisions for dealing with: establishment and functioning of UMTA, public lands, environmental policy, commuter rail continuation, Federal railroad safety, interstate commerce, wages, non-discrimination provisions for equal employment opportunity and civil rights, budget authority, demonstration cities, housing, relocation, and historic preservation.

Urban Mass Transportation Administration, Washington, D.C. 20590
1976; 135p 17refs
Availability: GPO, \$1.60, Stock No. 050-014-00007-0

HS-019 119

SIGNING TREATMENTS FOR INTERCHANGE LANE DROPS. FINAL REPORT

An interchange lane drop study was carried out to develop a uniform method of signing to warn drivers of interchange lane drops and to guide them to their proper route or destination. According to the definition given interchange lane drops encompass both exit lane drops and major splits where there is a reduction in the number of lanes available for through route traffic. Variations in ramp location and route continuity combine to make four basic exit lane drop types, and variations in the inclusion of an optional lane and the location of the through-route leg result in four basic split types. A literature review shows relatively little research has been done on the interchange lane drop problem. Studies showed the black-on-yellow panel with the message EXIT ONLY to be effective in reducing erratic maneuvers at right exit lane drops, but the best panel legend is questionable. Empirical evaluations showed EXIT ONLY and MUST EXIT to be equally effective leading to the conclusion that EXIT ONLY should be retained as the primary legend. Studies demonstrating the effectiveness of a diagrammatic treatment led to the conclusion that a diagrammatic should be used when the off-route is to the left of the through-route. A survey of State practices showed that interchange lane drop types are found in all States accompanied by widespread variation in signing. It is concluded that this variation is a major source of driver confusion and that uniform signing treatments, consistently applied, are required. Questions of lane drop information are raised pertaining to ambiguous instructions for use, applicability difficulties because of geometric configuration or route discontinuity, and difficulties in explicit lane assignment. It is concluded that these difficulties make a simple, straightforward analysis impossible at the present time and preclude a single standard for all interchange lane drop types. The main emphasis in developing of signing recommendations was in performance of a human factors analysis of problems associated with exit lane drops and splits, with specific attention to the needs of in-

dividuals unfamiliar with the roads being signed. An assessment of effects of unusual route and geometric design characteristics of interchange lane drops on these drivers showed that problems arose because of expectancy violations, with difficulty increasing with the number of expectancies violated. It is concluded that effective signing treatments need to restructure violated expectancies, fulfill information needs for all unfamiliar drivers in all lanes, and take into account all possible trip plans. Signing recommendations are developed using these criteria. These recommendations are incorporated throughout the text and are listed separately in Section VII of the report. Survey results are reported in Appendixes A and B.

by H. Lunenfeld; G. J. Alexander
Federal Hwy. Administration, Human Factors Branch,
Washington, D.C. 20590
1976; 182p 25refs
Rept. for Jun 1976.
Availability: NTIS

HS-019 120

A STUDY OF ROAD NOISE

A study considering causes and measurement of road noise and its relationship with a system of vehicle body vibration is reported. Vehicle components inputting vibrations to the system include tires, suspension systems, and vehicle body, all in interaction with road surface effects as radiated by the total vehicular system. Road input to a moving vehicle is considered in vertical and longitudinal directions (according to properties of system components). Vibration transmission was analyzed using mathematical modelling techniques: isolation, mobility, and validation. Dynamic properties of vehicle components and systems analyzed specified optimized modelling techniques using measured parameters, matrix multiplication, and input/output mobility or transmissibility for the system under required boundary conditions. Dynamic properties of stationary and rolling tires investigated include frequency range, speed range, variable load against a flat surface, vertical vibration of tire surface, flexural modes, springs, and dampers. Suspension components investigated for transmissibility include spring, damper, links, and rubber bushes. The properties of these components are measured and appropriate models constructed. A method of simulating the response of a vehicle body seen at the suspension input points is also described, and its performance compared with that of the equivalent physical system. Parameter changes are carried out both individually and by using optimization techniques, and conclusions are drawn as to reducing the vehicle body vibration. An analysis of effects of subframe mounting of suspensions showed little potential benefit. Vehicle body vibration can be minimized by parameter optimization routines, with the amount of reduction possible dependent on restrictions imposed on the values of parameters to be varied and on the effect of such variations on vehicle ride and handling performance. An example of optimization analysis is given in the case of the damper path. It is shown that variation of stiffness and damping of rubber bushes within reasonable engineering limits is allowed in order to minimize vibration transmission from the hub to the body through the damper without adversely affecting the low-frequency transmission of the whole suspension. A simulation curve shows the transmissibility of dampers against frequency using the optimum parameter values, and this curve can be compared with that of production damper bushes. Decrease of road noise is enhanced by use of optimization of components which constitute a significant proportion of vibration input to

the body before optimization. Appendices present information on mobility definitions and calculation of pertinent parameters.

by A. V. Phillips
Publ: Institution of Mechanical Engineers Proceedings P70-81
(1971)
Rept. No. C102/71; 1971; 6refs
Availability: See publication

HS-019 121

LIVEABLE URBAN STREETS: MANAGING AUTO TRAFFIC IN NEIGHBORHOODS. FINAL REPORT

The effects of auto traffic on street life and residential neighborhoods were studied as a basis for evaluation of efforts to manage traffic in residential neighborhoods and for proposing methods for carrying out and evaluating traffic management plans. Reports on some 500 home interviews taken in San Francisco on residential streets with varying volumes, compositions, and types of traffic are presented. Some reactions reported include: heavy traffic caused many people to move away from a street; people who remained on a street with heavy traffic adapted through withdrawal from their yards and even from the fronts of their houses; even on lightly traveled streets traffic safety was seen as a problem, but it was the occasional fast car considered rather than the continual traffic; and lightly traveled streets were occupied by more families, owners, and long-term residents than more heavily traveled streets. Following the home interview reports are descriptions of pioneering traffic management programs in three London boroughs, other international efforts to protect neighborhoods, and similar efforts in the San Francisco Bay area. The London area programs were planned to stop through traffic along certain routes in order to facilitate pedestrian access to open spaces and to prevent traffic running through internal streets of a residential superblock. A variation on this plan arranged a paired one-way system in order to maintain a through street for traders and shopping, although access was restricted to small vehicles. International efforts cited mainly pertain to restraining traffic in existing residential neighborhoods, some plans being part of urban rehabilitation programs. Other ideas being implemented include traffic control schemes and traffic cells designation. In the San Francisco area urban rehabilitation program the placement of diagonal divertors of many street intersections is acting to prevent through traffic and creates a number of traffic loops while concentrating traffic on fewer streets. A summary of traffic impacts is given, and proposals for a process of analysis, alternatives evaluation, and experimentation that can be undertaken by a city wishing to make its streets and neighborhoods more livable are given. Appendix A contains tabulated information on the interview results, while Appendix B gives details of interviewing methodology. Qualitative environmental characteristics and behavior traces noted during the interview project are discussed in Appendix C. An evaluation of traffic control devices and arrangements is given in Appendix D with consideration of the problems these traffic controls cause for emergency services usages. The questionnaire used in the London sample survey is presented in Appendix E.

by Donald Appleyard; M. Sue Gerson; Mark Lintell
Institute of Urban and Regional Devel., Univ. of California,
Berkeley, Calif. 94720
Contract DOT-FH-11-8026
Rept. No. Monograph-24; FHWA/SES-76-03; 1976; 476p
137refs
Rept. for Apr 1973-Nov 1975.
Availability: GPO

HS-019 122

A SIMPLIFIED, INTERACTIVE SIMULATION FOR PREDICTING THE BRAKING AND STEERING RESPONSE OF COMMERCIAL VEHICLES

An interactive computer program which predicts the response of trucks and tractor-trailers to braking and steering inputs is documented. The mathematical model simulating the vehicle and the input/output of the computer program have been designed to elicit simplicity of operation rather than extreme accuracy. Thus, quasistatic load transfer is used, and wheel spin degrees of freedom are neglected. Special features of the simulation include provisions for tandem axles with inter-axle load transfers, dual tires, brake imbalance, and the effectiveness of antilock braking systems. The program is designed for user convenience, employing a relatively small number of input parameters in order to simplify the parameter-gathering demands placed on the user. The program is written in an interactive form for use at a computer terminal. The user is guided by cues printed out at the terminal, so that the user can load the input data, operate the simulation, and tabulate vehicle response variables with only a limited familiarity with the computer program. Use of the computer program is recommended for making preliminary studies of new or proposed vehicle designs, addressing engineering questions concerning combined braking and steering maneuvers, planning large-scale vehicle test programs, or planning detailed simulation analyses using more complex vehicle models. An appendix contains a flow chart which indicates the options available to the user in running the computer program.

by Howard T. Moncarz; James E. Bernard; Paul S. Fancher
Highway Safety Res. Inst., Univ. of Michigan, Huron Parkway
and Baxter Rd., Ann Arbor, Mich. 48105
Rept. No. UM-HSRI-PF-75-8; 1975; 63p 10refs
Sponsored by the Motor Vehicle Manufacturers Assoc., 320
New Center Bldg., Detroit, Mich. 48202.
Availability: Corporate author

HS-019 123

AUTOMOBILE INSURANCE LOSSES. COLLISION COVERAGES. AN INVESTIGATION OF RELATIONSHIPS BETWEEN LOSSES AND ENGINE SPECIFICATIONS USING 1973 MODELS

A study was carried out to investigate relationships between the horsepower and weight to horsepower ratio and collision coverage losses among vehicles with several available engines. To obtain adequate exposure for vehicles with specific engines, the collision experience of 1973 model year vehicles over their first three calendar years of coverage was employed. Only vehicles from those market classes within which substantial horsepower differentiation between the engine options in many vehicle series was present - compact, intermediate, specialty, and sports - were included. The study showed that the losses, both in frequency and size of claims of vehicles relative to the overall experience of their series generally increased as their weight to horsepower ratio decreased, or as their horsepower increased. Because the range of available engines for different vehicle series within a market class and body style was similar and their relative exposures were comparable, the relationships between loss experience and engine power did not contribute substantially to the differences among the overall results for individual vehicle series within a market class and body style. Similarly, differences between the results for the four major market classes

- subcompact, compact, intermediate, and full size - which have been consistently reported, cannot be explained by relationships with engine power. Descriptions of the sources and nature of data are presented in Appendix A. Appendix B presents tables of detailed results for vehicles with specific engines. Appendix C contains definitions, and Appendix D lists vehicle series designations for 1973 models. Three figures illustrate relationships between weight to horsepower ratio groups and relative loss experience (collision coverages 1973 models); comparisons between engines within series (collision coverages 1973 models); and comparisons between engines within series (collision coverages, results by operator age group, 1973 models). Tabular material gives definitions of weight to horsepower ratio groups; loss payment summary by make, series, and engine; claim frequency per 100 insured vehicle years by make, series, engine, and operator age group; average loss payment per claim; average loss payment per insured vehicle year; and vehicle series designations by make and market class.

Highway Loss Data Inst., Watergate 600, Washington, D.C. 20037

Rept. No. RR-HLDI-A-6; 1976; 104p

Includes a list of other research reports published by the Highway Loss Data Inst.

Availability: Corporate author

HS-019 124

AUTOMOBILE INSURANCE LOSSES. INJURY COVERAGES. CLAIM FREQUENCY RESULTS FOR 1974 AND 1975 MODELS

Variations in the rate of injuries among different cars are measured through the use of automobile insurance data for injury coverages. The claim frequencies reported are based upon counts of crashes involving at least one medical claim under first-party coverages. Results are presented separately for two types of first-party injury coverages: medical payments (Medpay) coverages and no-fault personal injury protection (PIP) coverages. Detailed descriptions of both of these coverages are provided in Appendix A. The report is based on the experience of 1974 model year private passenger vehicles in the calendar period September 1973 through December 1975, and of 1975 model year vehicles in the calendar period September 1974 through December 1975. Claim frequency results are presented for vehicle market classes and for body styles within each market class, as well as for a limited number of individual vehicle series, those with the most exposure. Data for the report were supplied by four insurance companies: Allstate, Liberty Mutual, Nationwide, and State Farm. A description of the sources and nature of the data is presented in Appendix B. Table 1 summarizes the claim frequency results for medical payments coverages. Among the four market classes there was a strong relationship between the claim frequencies and vehicle size for both model years. The smallest vehicles (subcompacts) had the highest claim frequencies, and these were more than 50% higher than the lowest claim frequencies which were for the largest vehicles (fullsize). The relationships between the claim frequency and the four major market classes for vehicles with both youthful and no youthful operators for 1974 models are illustrated. The youthful operator claim frequency results were substantially higher than those for vehicles with no youthful operators. In both operator age groups there were strong relationships between vehicle size and claim frequency. Particularly noteworthy was the high medical claim frequencies for

youthful operators in smaller cars, especially subcompacts. Results presented provide additional evidence of the increased risk of occupant injury in crashes as vehicle size decreases. Other results of data analysis show that two-door model cars had usually higher loss experience than corresponding four-door models. Only small differences were found between claim frequency results for the 1974 and 1975 models. Table 2 summarizes claim frequency results for PIP coverages. Among the four major market classes, results paralleled those of the Medpay coverages: the smaller vehicles had the higher claim frequencies and vice versa. There were no significant differences in PIP coverages between the two model years. Table 3 summarizes results by operator age group for Medpay coverages for 1974 models, and Table 4 summarizes the same results for 1975 models, both tables including combined (unstandardized) claim frequencies, standardized claim frequencies, and 90% confidence limits on standardized claim frequencies. Corresponding results for PIP coverages are presented in Tables 5 and 6. Consistently higher frequencies for the youthful operator age group are apparent in the data. An appendix (C) of definitions and an appendix (D) of confidence limits calculations are included.

Highway Loss Data Inst., Watergate 600, Washington, D.C. 20037
 Rept. No. RR-HLDI-75-1; 1976; 44p 3refs
 Includes a list of other research reports published by the Highway Loss Data Inst.
 Availability: Corporate author

HS-019 125

PRIMARY PREVENTION IN ALCOHOL AND HIGHWAY SAFETY: RESEARCH NEEDS

Research needs for identifying and predicting drivers at a high risk of alcohol-related traffic accidents are discussed in relation to planning and evaluating countermeasure programs. Current knowledge about alcohol-related, crash-involved drivers as a target group according to predictor variables which meet established criteria is inadequate. The analysis of age and youth parameters in alcohol-related crashes has not shown a precise knowledge about the identity of the target group, other than that the group is relatively young. Sex differences are suggested as a definite parameter for prediction of the target group, although this category is again too general for precise identification within it of accident-prone individual target groups. Marital status when considered as a predictive parameter shows promise in that alcohol-related crashes statistically have often involved drivers with family problems. Race as a predictive parameter is ruled out on two grounds: controversy and nonrepresentativeness in specific investigation areas. Research on socioeconomic indicators show consistent relation to alcohol and driving behavior, with lower social and economic levels overrepresented in the accident-involved driver population. Psychological variables have been used with mixed success to predict driving behavior, but are not considered stable in correlations and reproducibility. General stress on the driver appears to be a valid predictor of accident involvement, but measurement and epidemiology of stress are too imprecise for use in intervention programs. The division of the driver's attention between stress content and the complex responses and behaviors needed for driving is seen to be of heightened importance when performance is additionally impaired by the effects of alcohol. Overall the valid parameters identified have not or can not be measured consistently and completely for use as predictors of alcohol-involved driver

populations prone to accident. The result is an imprecise prediction of individuals at high risk of alcohol-involved accidents. Acceptable countermeasure programs will require more precise identification of the target group. Research needed aimed at achieving this identification task for the purpose of developing primary prevention programs are outlined: data collection, etiology of drinking, circumstances of drinking, come of drinking, placement of the drinker in a driving task, placement or operations prevention in driving equipment, and social sanctions.

by Richard L. Douglass
 University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich. 48104
 Contract DOT-HS-4-00990
 1975; 22p 55refs
 Presented at the National Council on Alcoholism, Annual Meeting and Alcoholism Forum, Milwaukee, 30 Apr 1975.
 Availability: University of Michigan, Ann Arbor, Mich. 48104

HS-019 126

MINUTES MAKE THE DIFFERENCE

An account is given of an incident in the routine work strategy of the Jacksonville, Florida, emergency medical services (EMS) team, as an introduction to discussion of the state of EMS in the United States. The case cited involved a year old man with a heart attack who was picked up by emergency ambulance for attention from a trained paramedic who communicated with hospital personnel while en route to the hospital. The state of emergency services in the Jacksonville region is judged superior to such services in some of the urban and rural areas, especially as they were in the past. Reasons given for the lack and poor quality of some services include lack of or poorly trained personnel, lack of dispatching and priorities, and competition between professionals, entrepreneurs, and amateur volunteers. The National Highway Traffic Safety Administration (NHTSA) has been working in the EMS field by fostering improved emergency treatment standards, establishing training standards and programs for medical technicians, adopting design and equipment criteria for ambulances, and funding states interested in establishing coordinated EMS programs. Since 1967 when NHTSA first entered the field, growth of statewide training programs for ambulance attendants has gone from four states to 50 states, and almost 75% of the nation has access to improved EMS facilities. The Jacksonville EMS program is reviewed from its inception in terms of training, equipment, dispatching, and cost effectiveness. The Jacksonville program began in 1967 by using existing equipment and personnel in the Fire Department. Additional equipment and more specialized training for personnel were added in the next few years to reach the present state of service. Side effects of the EMS program have caused local hospitals to upgrade their emergency rooms as more accident victims are delivered alive needing emergency medical treatment. It is concluded that the Jacksonville EMS program is a success in every measure.

by Clyde T. Linsley, Jr.
 Publ: Transportation USA v1 n4 p10-2 (Summer 1975)
 1975

Availability: See publication

CAN WE LEARN TO DRIVE 55? IF PERSUASION DOESN'T WORK, ENFORCEMENT MAY

The need for and the growing practice of enforcement of the 55 mph speed limit in the United States are discussed. While the initial impetus for the lowered speed limit came from the 1974 Arab oil embargo as an emergency energy-conservation measure, the continuance of 55 mph as the national speed limit was assured by substantial drops in the highway accident death rate (18% in 1974). Various factors contributing to the decline have been accounted for, including a 3% drop in total highway driving due to high fuel prices and fuel scarcity, but safety authorities concluded that the 55 mph speed limit and slower average driving speeds were the primary factors in the drop in death rate. The side benefit of savings in fuel usage is also documented. It is noted that while public willingness to obey the 55 mph speed limit is not unqualified, the average speed has dropped. To assist the states in enforcement of the speed limit, several educational and enforcement measures are being taken, based on motivating drivers to save money as well as lives, such as the VASCAR electronic unit used in Virginia, defeats of anti-radar warning units in Texas by the old-fashioned procedure of following suspected speeders and clocking their speed, radar speed monitors and heavy ticketing practices in California, roadside speed readers which display the speed of a vehicle on an electric sign and strict enforcement of the 55 mph limit in Massachusetts, and strong public information programs advising of increased speed surveillance and enforcement policies in several states.

by John Demeter

Publ: Transportation USA v1 n4 p22-5 (Summer 1975)
1975

Availability: See publication

HS-019 128

DELAY AND FUEL CONSUMPTION AT TRAFFIC SIGNALS

A research study carried out in Gainesville, Florida, examined the trade-offs between fuel consumption and delay at signalized intersections. Traffic signals with specially adjusted timing have been shown to provide a savings of approximately one gallon of fuel per intersection per hour. Factors which affect fuel consumption were studied for affective reactions to traffic signal timing: vehicle design, use characteristics and driving conditions. Only in the third category are there factors to consider in estimating change in fuel consumption due to signal timing: total stopped delay and the number vehicles required to stop. Mathematical relationships are stated to represent these effects dependent on composition of traffic, approach, speeds, grades, and other conditions obtaining at the intersection. Using the assumptions and expressions developed, the relative fuel consumption for any specific signal timing plan can be estimated by calculating the estimated number of stops and total delay which would result from its implementation. Relevant computer programs to project such estimates are described in terms of the variables possible and the results desired. Two promising models used to estimate delay and stops in coordinated signal systems are TRANSYT and SIGOP-II. Both involve computer programs that use an iterative process to arrive at a set of solutions. In the case of figuring the trade-offs between delay and fuel consumption at traffic signals, use of TRANSYT is preferred, although SIGOP-II allows other machinations such as op-

work of 26 signals in Gainesville's central business district, and the relationship between cycle length and two measures of effectiveness (fuel consumption and minimum delay) is reported. For the signal network considered, it is concluded that fuel consumption could be lowered by approximately 44 gallons per hour if signals are timed with fuel consumption in mind rather than delay, causing the delay to increase by about 42 vehicle hours/hour. It is concluded that it is not practical to carry the fuel conservation philosophy to its limit in order to realize fuel savings with acceptable traffic delay. The point is made that the total benefit or detriment in the trade-off relationship is the sum of a large number of very small quantities, making judgments on the variables arrangement specific in a small scale of values.

by Kenneth G. Courage; Servando M. Parapar

Publ: Traffic Engineering v45 n11 p23-7 (Nov 1975)

1975; 6refs

Availability: See publication

HS-019 129

THE BENEFITS TO THE PUBLIC OF VEHICLE LEGISLATION--ATTEMPTS TO MEASURE THE UNMEASURABLE

A discussion on vehicle legislation benefits with regard to environmental issues is presented. A distinction is made between environmental liabilities arising from vehicles, which cause annoyance (such as noise, loss of peace and quiet, vibration, and visual intrusion) and those which endanger life and limb. It is found that legislation implemented to reduce either category will inevitably generate costs. It is suggested, therefore, that in evaluating legislation relating to environmental nuisance, attempts should be made to measure benefits; while for legislation relating to life endangerment an effectiveness approach should be adopted. Methods currently available to measure environmental nuisance arising from vehicles, such as opinion surveys, observing the effect of changes in some independent indicator, and simulation exercises are critically examined. Using evidence from the Urban Motorway Committee Reports, Noise Advisory Council, Transport and Road Research Laboratory surveys on the effect of traffic in selected high streets, and the Realistic Environment Assessment Laboratory's Social and Community Planning Research ping-pong technique, studies of house price differentials, and estimates of willingness-to-pay for exclusion facilities, an attempt is made to highlight the measurement problem. Essentially the dilemma is that while benefits of environmental nuisance legislation should be carefully weighted against antipollution costs, techniques currently available for measuring and assessing such benefits are not fully developed. Paradoxically there is a procedure of greater clarity for valuing benefits of policies affecting life endangerment. Official accident evaluation policy in the United Kingdom is described, including accounting for direct tangible costs, indirect tangible costs to the community, and intangible costs allowed for punitive and psychological damages. Legislation affecting life endangerment situations such as traffic accidents and urban pollution is outlined in terms of intent and application. The difficulty of effectively enforcing legislation of both environmental nuisance and

by T. Jennings
University of Leicester, United Kingdom
Publ: Transportation v4 n2 p159-74 (Jun 1975)
1975; 32refs
Availability: See publication

HS-019 130

SPARK PLUGS

The developmental history of the spark plug is reviewed from the seventeenth century to the present, giving details of design, electrical characteristics, and production processes. The first use of a modern-type sparkplug was cited in an 1860 gas engine patent utilizing a ceramic insulated, threaded plug. Other early sparkplug bodies had flanges and were held down against the low combustion pressures of the time. Around 1900 plugs reverted to threaded mountings, some with sealing gaskets. Early ceramic insulators were weak when subjected to mechanical/thermal shocks and contributed to engine damage through deterioration. Subsequent trends in engines toward smaller bores, larger valves, and higher compression ratios caused a reduction in plug size. Modern practice has largely settled on 14 mm and 18 mm thread diameters as standard industry sizes. Sparkplug designs as compromises between long life, anti-fouling requirements, voltage requirements, and cost have involved various configurations, primarily tradeoffs in design of electrodes and insulator tips to achieve broader heat ranges. Electrical characteristics of the sparkplug are related to voltage ranging from 3,000 to 25,000 volts, dependent on gap size, electrode shape and temperature, and compression pressure. Split capacitance plugs and resistor ignition cables were developed to offset problems of radio frequency interference with plug performance. Plug production processes and materials have been refined for the purposes of mass production, presently utilizing alumina ceramics, automatic stamping and firing, electrode placement, sheel joining, and inspection. Nearly indefinite availability of plugs made for cars of the past and present is a feature of the sparkplug industry.

by Larry Givens
Publ: Automotive Engineering v84 n7 p27-34 (Jul 1976)
1976
Availability: See publication

HS-019 131

THE FIRST CENTURY OF THE OTTO ENGINE

Development and refinements to the 1876 Otto 4-stroke cycle engine are discussed. Otto's internal combustion engine concept was the compression of a charge in the same cylinder as that used for combustion, with a unique method of charge stratification prior to fuel ignition. A prototype engine incorporating Otto's refined design concepts first ran in 1876, with a rated speed of 180 rpm and a compression pressure of 34 psi. Comparison of the Otto engine with predecessors and other prototypes showed its superiority in reduction of piston displacement and increase in brake thermal efficiency. A valid patent was issued for the hardware production of the engine. Refinements were tried in order to improve the engine and to bypass patent rights, such as lengthening expansion strokes to gain higher efficiency, using low compression oil (kerosene), and installing vapor mixing chambers, electric ignition, and

lightweight designs and dependability in performance. Electronic ignition was perfected in this period, with successful commercial production models made available before 1900. Automotive engines from 1900 to 1920 continued a trend toward practicality, and professional and commercial groups were formed to guide the development of a fledgling automotive industry. Dimensional tolerancing to permit parts interchangeability and mass production techniques were vital factors in growth of the sales and repair industries. Gasolines available for motor vehicle use were also improved and both aided and caused changes in engine instrumentation and design: electric starters, generators, battery lighting systems, fuel pumps, combustion chamber shapes, valve locations, cylinder casting, intake valves, timing regimens, ignition systems, magnetos, oilers, and pressure lubrication. Use of the internal combustion engine in aircraft and farm machinery greatly broadened the market and effects of its use. Fuel consumption figures before 1920 were a concern for comparing engine performance in terms of fuel consumption, acceleration, and maintenance. The automotive engine from 1920 to 1940 is characterized as evolutionary due to advances in metallurgy, ignition, carburetion, manufacturing, and fuel refinements. The automotive diesel engine was developed by 1923 and use of the type has continually increased with acceptability of the power plant and exorbitant fuel costs. The 1940-1960 engine developments concentrated on improved performance and fuel efficiency, with relatively more design innovations introduced outside the United States industry. The 1960's and 1970's have seen increased concentration on fuel efficiency, alternate energy converters, and environmental impact. New engine designs (rotary combustion, gas turbines, and stratified charge pistons) are strengthening the internal engine concept.

by C. Lyle Cummins, Jr.
Publ: Automotive Engineering v84 n7 p36-45 (Jul 1976)
1976; 1ref
Availability: See publication

HS-019 132

THE OTTO-CYCLE ENGINE: FORCE FOR CHANGE

Economic and sociologic change attributed to the invention of the Otto-cycle engine and its offspring (motor vehicles and aircraft) is reviewed. Production figures and trends in 10 major car-producing countries are examined, showing world production of 35 million motor vehicles in 1974 of which 26 million were cars. Worldwide registrations of motor vehicles was over 316 million at the end of 1974. Only the United States, Canada, and Australia are close to saturation of the motor vehicle market with 2-3 persons/vehicle. Production trends in the U.S. are static, while those in other countries are rapidly increasing. In 1974 U.S. production was only 29% of the world total. By 2016 it is estimated that 1.9 billion vehicles will be in use worldwide. The revolution in power and transportation modes is most obvious in developing countries, where labor supply and demand and resulting economic factors are impacted. The problems of world fuel supply and distribution have additional economic impact on both developed and developing countries, but not serving to slow down the trend toward more usage of motor vehicles. The societal impact of the Otto-cycle engine on life in the U.S. and other countries includes growth of suburbs, development of supermarket facilities and shopping areas, enlargement of an individual's orbit of life, rising overall wage levels, education accessibility

parison to engine power, expansion of resources, fashion changes in response to the automotive environment, expanded warfare capabilities, environmental changes (such as climate and soil fertility), world food supply and distribution, and personal values. The constraint on fuel resources is seen as a controlling factor in continuance of the ways of life brought about by the Otto-cycle engine.

Publ: Automotive Engineering v84 n7 p46-51 (Jul 1976)
1976; 1ref
Availability: See publication

HS-019 133

LIMITATIONS OF THE BARRIER EQUIVALENT SPEED CONCEPT FOR ESTIMATION OF CRASH SEVERITY

Of the various limitations of the barrier equivalent speed concept for estimation of crash severity, the major one is its inability to estimate experience of vehicle occupants in crashes due to the variable effects of amounts and rates of energy expended, since the barrier equivalent speed estimate is given only in terms of the amount of energy expended. An example of this phenomenon is given where the occupant of a large car striking a small car experiences a more severe crash than would be experienced in striking a rigid flat barrier to produce the same frontal crush. The closing speed of vehicles and occupant injury parameters were determined by the car-to-car crash model HEAD-ON and the occupant dynamics model MODROS, respectively. HEAD-ON was used to separately model hypothetical full-size, medium-size, and small-size cars being struck by a full-size car traveling in the opposite direction at equal speed, with closing speed selected to provide equal residual crush of the full-size car. MODROS was used to model the dynamics of the front seat passenger of the full-size car. Crash severity was assessed by analysis of the loads and accelerations sustained and by comparison of crash severity indicators. The crash severity sustained by the occupant of the full-size car in the three crashes modeled varied considerably, disproving the meaningfulness of barrier equivalent speed estimates for figuring occupant effects. Output variables are portrayed in snowflake diagrams providing a polar plot of how 35 variables compared percentagewise with those of the baseline crash. It is concluded that crash severity estimates may be based upon different variables which are complex and not easily interrelated, such as dissipation of energy, kinematics, and protective geometry.

by John P. Danforth; Kuang-Huei Lin
General Motors Corp., Res. Labs., Warren, Mich.
Rept. No. GMR-1953; 1975; 28p 8refs
Availability: Corporate author

HS-019 134

RIGHT TURN ON RED. A REPORT TO THE GOVERNOR AND GENERAL ASSEMBLY OF VIRGINIA

A study was conducted on right turn on red (RTOR) practices to determine whether Virginia's 1972 sign permissive RTOR law should be retained, rescinded, or amended. The scope of the study included a literature survey, a survey questionnaire administered to Virginia traffic engineers, a telephone survey of traffic engineers in other states, field studies of vehicle

crashes at 20 intersections in Virginia before and after RTOR was permitted. Results of the study show that RTOR signals can enable motorists to effect substantial savings in time and concomitant savings in gasoline by reducing vehicle idling time at intersections. The average saving for right-turning delayed vehicles was found to be 14 seconds. Since the general permissive rule for RTOR allows the maneuver at a greater percentage of approach legs than does the sign permissive rule, time and energy savings have been estimated to be greater statewide under the general permissive rule. Estimated savings in gasoline under the general permissive rule would be over three million gallons annually. No significant increase in traffic crashes was found in Virginia, and no increase would be expected with the general permissive rule, as none has been experienced in any other state with either the general permissive or the sign permissive rule. Moreover, study data reveal that traffic conflicts and thereby crash potential are actually reduced under RTOR, and that crashes which do occur because of RTOR are generally not severe. When the total impact of RTOR was considered, the evidence was found to support the recommendation that Virginia implement the general permissive rule for RTOR. Twenty-six appendixes containing the data gathered in the studies described, pertinent legislative materials, and survey materials are also included.

by Martin R. Parker, Jr.; Robert F. Jordan, Jr.; Jeffrey A. Spencer; Melvin D. Beale; Larry M. Goodall
Virginia Hwy. and Transportation Res. Council,
Charlottesville, Va.
Rept. No. VHTRC-76-R9; Senate Doc-5; 1975; 151p 27refs
Availability: Commonwealth of Virginia, Dept. of Purchases and Supply, Richmond, Va.

HS-019 136

PRELIMINARY ANALYSIS OF THE CAB-OVER-ENGINE VS. THE CAB-BEHIND-ENGINE DESIGNS

Preliminary analysis of cab over engine (COE) vs cab behind engine (CBE) designs for commercial vehicles is presented. The COE design has evolved through attempts by truck manufacturers to optimize payload and still conform to axle weight, gross weight, and length limitations. COE design represented 24% of total truck population in a 1972 survey of commercial vehicles, with percent of COE designs increasing in each gross vehicle weight category. Although CBE designs account for more than three times as many vehicle miles for vehicles greater than 10 kips than COE designs, the weight classification increases for COE designs are showing a trend toward increased use of COE designs making safety assessment and comparisons necessary. Accident experience, handling characteristics, sight distance, fumes, noise, space restriction, and bridge fatigue for COE and CBE designs are compared. Accident rates for COE designs are 4:1 compared to CBE designs, with higher rates of injuries and fatalities. COE handling characteristics are problematical in both the loaded and bobtail configuration due to stability parameters. COE designs appear to have increased visibility and sight distance advantages, while fumes and noise are considered equal in the two configurations. COE designs restrict space for drivers, possibly causing fatigue and inadequate sleeping arrangements. Bridge fatigue relative to COE vs CBE designs is inconclusive. Studies of design effects on these general problem areas are being planned to generate more reliable conclusions, keyed to accident analysis through proceduralized collection of accident

by Julie Anna Fee; Martha Schwendeman
Federal Hwy. Administration, Offices of Res. and Devel.,
Washington, D.C.
1976; 27p 11refs
Availability: Corporate author

HS-019 137

NOVEMBER TRAFFIC DEATHS DROP 8 PER CENT

A summary and discussion of motor vehicle deaths recorded in Nov 1975 and cumulative to that month are presented. The number of deaths totaled 3,910, a decrease of 8% from the November 1974 total of 4,250 and a decrease of 12% from the pre-energy crisis November 1973 total of 4,453. Deaths for 11 months of 1975 are also tabulated, totaling 42,030, a decrease of less than .5% from the 11 month total for 1974 of 42,170 and a decrease of 19% from the corresponding 11 month period in 1973. Disabling injuries for the 11 months are estimated at slightly more than 1.5 million, and cost of motor vehicle accidents for 11 months of 1975 is estimated at \$17.7 billion. Preliminary vehicle mileage reports for 1974 show the estimated mileage death rate to be decreased by 3% from the 1974 rate. State and city experiences and comparisons are also described. Tabulated data are presented on traffic death rate reductions at the end of November 1975 by state and city, changes in motor vehicle deaths estimates for 1975, city records on traffic deaths, and state records on traffic deaths. Motor vehicle deaths and injuries data by states in the period 1974 and 1975 are also tabulated. Trends in evidence from analysis of the data indicate continuing drops in the death and injury rates.

by J. L. Recht
Publ: Traffic Safety v76 n2 p28-33 (Feb 1976)
1976; 1ref
Availability: See publication

HS-019 138

MOTOR TRUCK SIZES AND WEIGHTS, LENGTH, WIDTH, HEIGHT, WEIGHT. LEGISLATIVE SUMMARY. INTERSTATE SYSTEM. COMMENTS AND EXCEPTIONS

Graphic tabulation of the trend pattern of individual motor truck sizes and weights are presented as an aid to manufacturers and legislators. Maximum legal lengths, widths, and heights are shown for buses, trucks, trailers, and combinations, with a section on comments and exceptions to cover exceptional cases. Motor truck weights are shown for various single units and combinations in practical gross weights or maximum gross vehicle weights. Differences in allowable loading are discussed according to state regulations on truck component arrangement and availability. Length data are presented for buses, straight truck, trailers semi and full, tractor semitrailer, truck and full trailer, tractor and semitrailer and full trailer (double), truck and two full trailers, tractor and semitrailer and two full trailers (triple), and minimum tandem axle spacing. Height data and width data are given for all vehicles considered. Weight data are given for vehicle and combination gross weight basis, per inch tire width, per single axle, per tandem axle with 48 inch spacing, two axle single unit, three axle single unit, 4 axle single unit, two axle tractor

two axle trailer, tractor and semitrailer and full trailer five axles (double), and maximum gross vehicle weights interstate system tables document maximum weight and limits. Comments and exceptions information is presented length, width, height, and weight limits. 1975 legislative summaries relating to the limits listed are also provided in category.

Motor Vehicle Manufacturers Assoc. of the U.S., Inc., M
Truck Manufacturers Div., 320 New Center Bldg., Detroit
Mich. 48202
1976; 31p 1ref
1976 edition.
Availability: Corporate author

HS-019 139

NOISE DISTURBANCE AND SAFETY IN TRAFFIC

The means used for reducing the noise caused by motor vehicles are discussed and results achieved by these measures reported. The problem of noise pollution is considered the aspects of sources of noise production and countermeasures used against noise in Italy. Specific attention is given defining environmental, psychophysiological, and disturbances and safety effects of noise. It is known that workers develop noise-related pathologies after measurable exposure to certain levels and intensities of noise, including hearing decrement and neurological symptoms. The pathological picture presented justifies the ecological approach to problems of noise, suggesting that its industrial, progress sources may also be able to produce solutions. Fixed sources identified include domestic, industrial, service and commercial, and leisure and pleasure activities. Mobile sources include urban traffic (trams, buses, trolleybuses, public transport motor lorries, tanker lorries, motor vehicles, motorcycles, mopeds, railway traffic, and air traffic. The main sources identified as the traffic of internal combustion engine vehicles including noises emanating from vibrations, structural transmissions, fans, gears, road and traffic conditions, emission suction systems, tires to road noises, and human behavior use of equipment. Research on the Italian urban noise situation shows average levels ranging from 70 to 90 decibels in various cities. Acoustic instrumentation and its function application in monitoring and controlling motor vehicle noise pollution are described: band pass filter set, beat frequency generator, measuring amplifier, level recorder, instrumentation recorder, turntable, pistonphone, impulse precision sound level meter, and sound level meter. Exhaust silencers and acoustic signalling devices are seen as principal means of controlling motor vehicle noise. Although acoustic signals contribute to the noise problem, these devices as used for signalling are termed inadequate for their intended purpose of warning drivers. Studies of the Phonometric Division of the Testing Center for Motor Vehicles are outlined and discussed covering signalling devices, acoustimetric tests, and anechoic chamber tests.

Centro Prove Autoveicoli e Dispositivi of Rome, Viale de
Provincie, 155-Rome, Italy
1972; 131p
Availability: Corporate author

CRITIQUE OF SAM PELTZMAN'S STUDY THE EFFECTS OF AUTOMOBILE SAFETY REGULATION

The variables used in Peltzman's previous analysis of the effects of automobile safety regulation are reviewed. It is concluded that some of the variables were arbitrarily chosen, that some were correlated, and that important factors were omitted, leading probably to some spurious and biased correlations. Peltzman's time series regression equations were reconstructed and found unstable, making them useless for predictions which are one basis for Peltzman's conclusions. The cross-sectional analyses in Peltzman's study were found to be unvalidated. Their results for important factors disagreed with those from the time series analysis. Peltzman's conclusions on the role of young drivers were compared with their actual accident involvement and were found to disagree. To illustrate the misuse of trend models, a model for pedestrian deaths is constructed following Peltzman's method which leads to conclusions contradicting published facts. The pedestrian model predicts pedestrian death rate for the years 1966 through 1972. Comparison of predicted values with actual values shows that the values disagree, actual being less than predicted. Thus the conclusion is that automobile regulation did reduce the number of pedestrian deaths below that which would have occurred without regulation. It is concluded that Peltzman's conclusions that motor vehicle safety regulation has had no effect on the highway death toll, that it may have increased the toll borne by pedestrians, and may have increased the total number of traffic accidents are not supported.

by H. C. Joksch

Publ: Accident Analysis and Prevention v8 n2 p129-37 (Jun 1976)

1976; 21refs

See also HS-019 141, HS-017 477, and HS-016 511.

Availability: See publication

HS-019 141

THE EFFECTS OF AUTOMOBILE SAFETY REGULATION: REPLY

Reply is given by the author to a critique of his previous study of the effects of automobile safety regulations. Specific issues addressed are the bias in results engendered by model misspecification and errors of measurement in the data. Procedures for structuring the models previously described are defended, relating the empiricism necessary to model studies to the direction and magnitude of bias it may reflect and suggesting that no model can represent theoretical variables perfectly. The major objection which was raised to Peltzman's model structuring was the use of a death rate rather than statistically validated number of deaths and related adjustment of the death rate to standardize for urban-rural and highway design effects on the rate. It is argued that the use of such rates and rate adjustments reflects no bias for the hypothesis concerning automobile safety regulation and that the direction of information provided by their use is not dictated toward hypothesized results. Empirical data are tabulated using a regression coefficient to demonstrate the negligible effect which highway safety legislation has had in actual accident statistics as compared to that which could be expected if such legislation were having a positive effect. Importantly, the regression analysis leads to the same conclusion about the negligible value and effects of highway safety regulations as previously stated by the author because there is no demonstrable difference in the ac-

adjusting correlative statements to include more observations and by reestimating results. Three conclusions are reached. Namely, the conclusion that safety regulation has failed to contribute to the decline in death rates does not rest on statistical illusion or obvious bias in statistical procedure but on the ability of conventional statistical techniques to isolate regularities in behavior of death rates that persist unchanged after safety regulation became effective. It is further concluded that data so far analyzed are inconsistent with the hypothesis that safety regulation has realized its intent in positively affecting highway safety. It is finally concluded that a priori reasoning about potential analytical pitfalls is a limited contribution to empirical knowledge, which could better be advanced by more accurate estimate of the effects of safety regulation on highway safety.

by Sam Peltzman

Publ: Accident Analysis and Prevention v8 n2 p139-42 (Jun 1976)

1976; 8refs

See also HS-017 477, HS-016 511, and HS-019 140.

Availability: See publication

HS-019 142

GETTING MORE MILES TO THE GALLON

Measures for achieving better fuel economy are described and evaluated with emphasis on speed controls and interface drag controls. Devices and techniques described include wind deflectors, detuned engines, automatic retrofitted fan drives, radial tires, needle nose configurations for streamlining wind effects, minimizing gap distances, semi-fairing of the gap, reduced axle numbers, flotation radial tires, diesel engines fitted with automatic or manual transmissions, road-speed governors, economy engines combining high torque-rise/constant horsepower or high torque-rise/constant horsepower with reduced operating rpm, and driver training with emphasis on fuel conservation. Some combinations of these devices and techniques have been demonstrated and analyzed in fleet equipment systems offered or used by Ryder Truck Lines, Mack Truck, Cummins Formula, Caterpillar, Aero Mayflower, Tesco, and United Parcel Service. Operation of these systems in actual road conditions has indicated savings in fuel from 3 to 35%, depending on the type of equipment involved and operational parameters. Engine modifications and air resistance streamlining have received the most attention in industry development and use, but work on trailer design is also discussed.

by Jim Winsor; Richard Cross

Publ: Commercial Car Journal v30 n5 p94-103 (Jan 1976)

1976

Availability: See publication

HS-019 143

THE STABILITY AND CONTROL OF MOTORCYCLES

Mathematical models of a motorcycle and rider dependent on three alternative assumptions concerning the tire behavior are developed. The three assumptions are to allow the tires no sideslip freedom, to allow the tires sideslip freedom but ignore the lag between the steering of a pneumatic tired wheel and

the building up of the side force towards a steady state value, and to consider the lag between the steering of a pneumatic tired wheel in conjunction with allowing the tires sideslip freedom. Stability characteristics deduced from them are compared, and minimum requirements for the model greater than have been previously satisfied are established. Using the most sophisticated (dynamic) model, the effects of design changes are calculated and design implications are discussed. It appears that straight line stability problems in motorcycles will have one of three origins: excessive low speed instability of the weave mode, excessive instability of the capsize mode at medium speeds, and instability or lack of damping of the oscillatory modes at high speed. The degree of instability in the first two instances is not known, but oscillatory instabilities of the machine with frequency in excess of about 2 Hz are not considered tolerable nor controllable by the driver. Positive design changes to increase stability include lowering the rear frame mass center, moving forward the rear frame mass center, moving rearward the front frame mass center, and increasing the rear wheel inertia. Other design changes suggested may bring both advantages and disadvantages, such as increasing steering damping, steepening the steering head, increasing front wheel inertia, and moving the rear wheel rearwards. It is concluded that fixed control characteristics of the motorcycle are unimportant for stability, and that steady state response to steering torque is probably of secondary importance. A proper representation of the free control characteristics requires the use of at least an eighth order model in which the tire relaxation property is included. Stability characteristics can be significantly controlled by practical design changes and the model developed can be used to study individual designs to assist in their optimization in the pre-prototype and prototype states of production.

by R. S. Sharp
 Publ: Journal of Mechanical Engineering Science v13 n5 p316-29 (1971)
 1971; 14refs
 See also HS-019 144.
 Availability: See publication

HS-019 144

THE INFLUENCE OF FRAME FLEXIBILITY ON THE LATERAL STABILITY OF MOTORCYCLES, RESEARCH NOTE

A mathematical model of a rigid framed motorcycle running freely was extended to include the effects of torsional flexibility between the rear wheel and the frame. The addition of the rear wheel's freedom to camber leads to an additional equation of motion, and to some further terms in previous equations. The appropriate terms are derived in Appendix 1 from a consideration of additional kinetic and potential energy terms arising and from Lagrange's equation. Results consist of the natural frequencies and damping factors as a function of forward speed for a range of values of torsional stiffness of the rear forks. In each instance, sufficient fork damping is included to make the rear wheel motion 1/10 critically damped when freely vibrating on the fixed rear frame. Damping factors for the oscillatory modes are plotted against forward speed, with the circular frequencies shown against appropriate parts of the curves. It is found that the effect of fork flexibility on capsizing is negligible and on wobble slight, particularly in comparison with the effect of steering damping. The effect on weaving, however, is to significantly increase it above about 60 ft/s (18.3 m/s). As the fork stiffness is reduced, the speed at

which minimum damping of the weave occurs is also reduced so that excessive weaving may occur even at moderate speeds. Reducing the fork stiffness below 2000 lbf ft/rad (271 Nm/rad) causes the weave to become unstable well within the speed range studied; while increasing the stiffness beyond 8000 lbf ft/rad (10,840 Nm/rad) brings diminishing stability returns. It is concluded that torsional flexibility in the rear forks of a motorcycle will reduce damping of weaving at medium and high speeds, while affecting the capsize and wobble modes very little.

by R. S. Sharp
 Publ: Journal of Mechanical Engineering Science v16 n2 p117-20 (1974)
 1974; 1ref
 See also HS-019 143.
 Availability: See publication

HS-019 145

MOTORING GOES METRIC IN NEW ZEALAND. A CASE STUDY

A case study of change to metric weights and measures in New Zealand is documented with regard to the task of transition in the transportation sector. Overseas and coast shipping, aviation, railways, and road transportation were involved in either commercial (including operating costs and charges relating to distances, to load weight, and to cubic capacity of the load) and legal aspects (conversion of speed limits; distances in contexts such as destinations, visibility for overtaking, and clearances; tire tread depth requirements; weights of vehicles and axle loadings; taxation regulation of metric unit tire pressures; and new map production). Plans for the transition to the metric system were formulated and announced, and hardware and software preparations were made for quick implementation of metrics in all areas impacted. Problems met during the planning and transition period included publicity measures, legislation for provisioning and implementing the transition, and some retraining of drivers (especially commercial drivers). A publicity handout describing the objectives and means of transition to the metric system included to illustrate the approach. The transition process and results were reported to be successful, largely attributable to division of the project into tasks affecting separate portions of the transportation conversion project and phasing of implementation measures.

by Ian Stevenson
 Publ: American Metric Journal v4 n1 p53-7 (1976)
 1976
 Availability: See publication

HS-019 146

THE SEAT BELT USE LAW IN ONTARIO, CANADA. INITIAL EFFECTS ON ACTUAL USE

Seat belt use by drivers and passengers in automobiles was observed during three periods in relation to assessing initial effects of a mandatory belt use law in Ontario, Canada. The three periods of observation were Dec 1975, the month before the law went in force; Feb 1976, the second month the law was in force; and Jun 1976, after the law had been in force more than five months. Although an increase from 23% driver lap belt use in Dec to 75% use in Feb was found, by Jun only 51% of drivers were using available lap belts. Shoulder belt

use by drivers and right front passengers in cars equipped with such belts was 17% in Dec, 65% in Feb, and 36% in Jun. While representing some progress in vehicle occupant crash protection, belts and laws requiring their use are judged inadequate as solutions to the problem of deaths and nonfatal injuries endemic to motor vehicle travel. Alternative measures to reduce hazards to automobile accidents are suggested including better vehicle design to reduce ejection in crashes, cushions which automatically inflate in severe forward decelerations, and removal of rigid objects from roadsides.

by Leon S. Robertson
Insurance Inst. for Hwy. Safety
1976; 16p 13refs
Prepared in cooperation with the Ontario Ministry of Transportation and Communication.
Availability: Corporate author

HS-019 147

INVASION OF THE AUTOROBOTS

The scenario and the human factors occurring in common traffic accident situations are discussed with relation to proposals for a computer-controlled car as a safety measure. An accident situation involving a driver concentrating intently on driving an automobile with superior equipment and capabilities meeting and almost colliding with a less well-equipped and less capable car driven by a distracted and careless driver is presented to illustrate the performance level sometimes required in driving tasks to avert an accident. Indirect methods of implementing computer technology for driver convenience and safety are cited, including traffic light system timing. Other, more direct methods are being considered, such as automatic regulation of starting and stopping in serial positions (stop lights or entry-exit ramps) and guideway driving (computer-to-computer vehicle control through entry into programmed highway systems). The autopilot systems being considered are seen as technically feasible although not humanly desirable. The likelihood of such systems being favored over human drivers for potential safety and efficiency benefits is predicted. Drawbacks such as improper machine maintenance and machine failure are suggested as introducing new accident scenarios to an already dangerous situation. It is suggested that human error as a basis for development of autopiloted vehicles implies the possibility that human error will still exist in machine systems from production through maintenance, and that human override is still needed in the likelihood of such error.

by Thomas A. Easton
Publ: Road Test v12 n9 p26-9 (Sep 1976)
1976
Availability: See publication

HS-019 148

A NATIONAL STUDY OF ADOLESCENT DRINKING BEHAVIOR, ATTITUDES AND CORRELATES. FINAL REPORT SUMMARY

A research project studying the extent and nature of adolescent alcohol use in American is reported. Aims of the project were to obtain demographic, socialization, and personal data on junior and senior high school students for a representative sample of students; to develop baseline measures of alcohol-drinking behavior and of the utilization of alcohol and selected drugs and to investigate the relationship of

these measures to relevant demographic, socialization, personal, and other measures; to obtain data relating to the circumstances surrounding adolescent drinking including measurements relating to the circumstances of alcohol usage; to obtain data for studying actual or perceived peer group or social pressures toward drinking and use of other selected drugs; and to measure respondents' knowledge, beliefs, and attitudes related to alcohol. A sample was stratified in two stages for specific populations and/or racial/ethnic groups. Data were obtained by a self-administered questionnaire, which was completed by 13,122 students. Results show that a greater percentage of boys than girls drink and that drinking and increased level of drinking are strongly related to increasing age. Black students are most likely to be abstainers and have the lowest percentage of moderate/heavy and heavy drinkers, while Whites and American Indians show an opposite characteristic. The effect of belief in traditional religious values on drinking levels is strong, as demonstrated in correlations made in the abstainer and moderate/heavy and heavy categories. Drinking patterns across parents' occupational groups indicate great similarity. Adolescents in the South were shown more likely to be abstainers than adolescents in other parts of the country and have the lowest percent in all drinking levels except infrequent. Based on the urbanization measure available, adolescents in areas classed as metropolitan exhibited similar drinking patterns to adolescents from nonmetropolitan areas. Peer-group pressure and social-function aspects of exposure to and consumption of alcohol are emphasized. Use of drugs by students did not correlate equally with use of alcohol, although a substantial percentage of students had had experience with drugs such as marijuana (22%). A large percentage of respondents reported having been drunk at least once during the previous year (45.6%) compared to more than 70% of the students who had had a drink of alcohol in the past year. Drinking while driving or sitting in a car at night was common to almost 40% of adolescents interviewed. Some 30% of students were classified as problem drinkers. It is concluded that the large number and percentage of drinking adolescents who also drive represent a problem factor in highway safety.

by J. Valley Rachal; Jay R. Williams; Mary L. Brehm; Betty Cavanaugh; R. Paul Moore; William C. Eckerman
Research Triangle Inst., Center for the Study of Social Behavior, Res. Triangle Park, N.C. 27709
Contract HSM-42-73-80(NIA)
1975; 18p 23refs
Rept. on RTI Proj. No. 23U-891.
Availability: Corporate author

HS-019 149

TRAFFIC ACCIDENT FACTS 1975. CITY OF PHILADELPHIA

Philadelphia traffic accident facts for 1975 are presented and analyzed in comparison with those for the year 1974 and with national averages. Of 62,754 recorded traffic accidents, there were 99,188 individual drivers and 115,838 motor vehicles involved, showing an incidence increase of less than 1%. The 176 deaths in 1975 (87 vehicle occupants, 85 pedestrians, and 4 bicyclists) constituted a 3% decrease over the 1974 figure of 182 deaths, while the 20,148 personal injuries recorded represent less than a 1% decrease. There were also 3,745 pedestrian injury accidents, 10,592 other personal injury accidents, and 48,250 accidents involving only property damage, showing 2% decrease, 1% increase, and 1% increase in respective categories. A breakdown of the 1975 personal injury record of 20,148 indicated that 3,959 (20%) were pedestrians,

805 (4%) were bicyclists, and 15,384 (76%) were drivers or occupants of motor vehicles. The estimated motor vehicle death rate in Philadelphia for 1975 was 3.8/100 million miles of travel, compared with the national death rate (urban and rural) of 3.5/100 million miles of travel. The reduction in speed limit to 55 mph was not credited in accounting for reductions. Economic loss from the 1975 accidents was estimated in excess of \$124 million, counting wage loss, medical expense, insurance cost, property damage, and indirect costs. The loss in human suffering and personal loss was also considerable but is not accountable. Causal factors in these accidents were investigated, showing over-involvement of children, the elderly, and drivers who violate traffic regulations or safe driving practices. Accident prevention activities suggested include traffic engineering, enforcement, and safety education. The need for traffic safety indoctrination for either driving or pedestrian Philadelphians is stressed.

City of Philadelphia, Traffic Engineering Div., Dept. of Streets, Philadelphia, Pa.
1975; 39p

Availability: City of Philadelphia, Philadelphia, Pa.

HS-019 150

RECOVERY AND SKILLS RELATED TO DRIVING AFTER INTRAVENOUS SEDATION: DOSE-RESPONSE RELATIONSHIP WITH DIAZEPAM

Skills related to driving, the ability to discriminate the fusion of flickering light, and hand and foot proprioception were measured double-blind in 34 healthy volunteers before and after three doses of intravenous diazepam, a sedative drug used for outpatient anesthesia. The effects of diazepam were most harmful to coordination. With 0.15 mg/kg, 0.30 mg/kg, and 0.45 mg/kg of diazepam the impairment of coordinative skills was statistically significant up to 2, 6, and 8 hours, respectively. No impairment of performance on any test was measurable at 6 hours after 0.15 mg/kg or at 10 hours after 0.30 or 0.45 mg/kg of diazepam. There were large interindividual variations in serum concentrations of diazepam within each dose level. The increases in serum concentrations of diazepam after the intake of food support the concept of an enterohepatic cycle for diazepam. It was concluded that patients should not drive or operate machinery for at least 6 hours after 0.15 mg/kg of intravenous diazepam and for at least 10 hours after 0.30 mg/kg and 0.45 mg/kg diazepam. (A common brand name of diazepam is valium.)

by K. Korttila; M. Linnoila
Publ: British Journal of Anaesthesia v47 n4 p457-63 (Apr 1975)
1975; 12refs
Availability: See publication

HS-019 967

VEHICLE PERFORMANCE--NEW AND EVOLVING TECHNOLOGY. HOW MUCH CONSERVATION AND HOW SOON?

The performance and fuel economy of an automobile can be affected by its weight and size, engine improvements, drivetrain (transmission) changes, aerodynamic drag and accessories. The weight of domestic automobiles has increased significantly over the past ten years but concern over fuel conservation has created a desire for reductions in automobile weight. This may be achieved by substituting lighter-weight

materials like aluminum or plastic for steel, and larger cars may also achieve a small reduction by more weight-conscious detail design, but the development of lighter-weight cars should be accompanied by incentives like a progressive weight tax to discourage owners from purchasing cars in higher weight classes. The fuel economy of an engine will be improved if it is properly tuned. Fuel economy can also be improved by a mechanism to vary the valve timing for high and low engine speeds or by mechanisms which give the cylinders either a completely homogeneous mixture or a stratified mixture with the fuel-rich part around the spark plug. Manual transmissions use less fuel than automatic, but the fuel economy of automatic transmissions could be improved by adding a fourth gear or by switching to a continuously variable transmission. Fuel consumption can also be decreased by designs that reduce aerodynamic drag. Accessories include auxiliaries like the oil pump, fuel pump, water pump, distributor and emission control devices which are necessary for the operation of the engine and items for passenger or driver convenience like air conditioning and the power steering pump. While no large improvements are to be expected in the fuel economy of these accessories, detail changes in the design and drives of the components can have some favorable effect. Incorporating all these changes could improve fuel economy by about 35%. There is need for research to determine whether there can be additional improvements or whether we should consider an alternative engine like the Stirling or Brayton cycle engines.

by Stephen E. Blake
Transportation Res. Board, 2101 Constitution Ave., N.W., Washington, D.C. 20418
Publ: HS-018 913 "Energy Conservation in Transportation and Construction, Conference Report," Washington, D.C., 1976? p132-41
1976?; 8refs
Presented at a Conference held 2-5 Dec 1975 in Atlanta, Ga.
Availability: In HS-018 913

HS-801 949

RESEARCH SAFETY VEHICLE (RSV), PHASE 2. STATUS REPORT NO. 6, 16 MAY TO 15 JULY 1976

Effort continued in all planned work areas during the reporting period. The crush/crash test vehicle structural development effort is the only exception to the general satisfactory progress reported. The delays in vehicle/part procurement make it necessary to greatly accelerate the effort. The failure of static crush test articles one and two to produce results which could be viewed as satisfactory for the RSV (Research Safety Vehicle) was noted. Work was implemented on the fabrication of the RSV mock-up, with completion anticipated by early September, 1976. Aspects of design engineering, testing, producibility, specifications review, and the Phase 4 Test Plan are reported. An outline of work planned for the next reporting period is included as well as a calendar of meetings held during the period.

Calspan Corp., Buffalo, N.Y. 14221
Contract DOT-HS-5-01214
Rept. No. ZM-5793-V; PR-6 ; 1976; 127p
Availability: Reference copy only

HS-801 963

SUMMARY OF ASAP RESULTS FOR APPLICATION TO STATE AND LOCAL PROGRAMS. VOL. 1-ASAP FINDINGS. FINAL REPORT

The Alcohol Safety Action Program (ASAP), sponsored by the Department of Transportation's National Highway Traffic Safety Administration, is described in terms of concept, successes, failures, and new knowledge about highway safety. ASAP is a systems approach to the drinking-driving (DD) problem on a state-by-state basis with emphasis on evaluation of individual countermeasures. ASAP has been successful in producing a health care delivery system for the problem drinker; causing cooperation and understanding among highway safety, criminal justice, and health care delivery systems; catalyzing individual states into DD problem action; and demonstrating an economic alcohol countermeasures program. ASAP has failed to produce significant reduction in alcohol-related highway deaths and to design optimal individual countermeasures for arrest rate deterrence, modal court systems, recidivism prevention, local funding, policy changes, and punishment deterrence. ASAP impact on enforcement, court, pre-sentence and probation, education and rehabilitation, and public information and education countermeasures is evaluated. These studies showed that ASAP has improved and increased DD arrests, illuminated the determining role of prosecution in court handling of DD cases, outlined realistic traffic safety court system processes with increased judicial cooperation, initiated the practice of pre-sentence investigation, improved probation capabilities of the courts, referred large numbers of DD offenders to rehabilitation agencies, and created and disseminated educational materials related to the DD problem. The positive value of the management functions of ASAP in bringing about these results is demonstrated. The basic recommendation for ASAP management effectiveness is to obtain a professional, full-time management unit that is communicative with and funded by both Federal and local funds. State and community alcohol countermeasure programs are listed in Appendix A by national region. Appendix B presents methodology and results for attributing accident reductions to ASAP, finding that the program has had a significant impact on the social drinker-driver but very little impact on the problem drinker-driver.

by Thomas E. Hawkins; Gary J. Scrimgeour; Richard F. Krenek; Charles B. Dreyer
Southwest Res. Inst., San Antonio, Tex.
Contract DOT-HS-5-01150
1976; 105p 10refs
Rept. for 1970-1975.
Availability: NTIS

HS-801 968

TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: INTERIM REPORT 2

Data on traffic accidents were collected on three levels of detail and analyzed for causal trends: A - police reports and other baseline data on the Monroe County, Indiana, study area; B - on-site information from investigations at the scene of traffic accidents; and C - in-depth examination of data from some on-site accident reports. Trend analysis of data shows that human factors (improper lookout, excessive speed, inattention, and improper evasive action) caused most accidents (77-95%), followed by environmental (view obstructions, slick roads, and roadway design problems) (13.8-34.9%), and vehicu-

lar (gross brake failure, brake imbalances, inadequate tread depth, and under-inflation of tires) (4.1-12.6%) factors. Alcohol impairment of drivers was the most frequently implicated human condition, and vehicles over seven years old were overrepresented in accidents caused by vehicular factors. Downward trends were identified for four on-site data causal factors: inattention, improper evasive action, false assumption, and improper driving technique; one factor trended upward; driving technique inadequately defensive. Improper evasive action also trended downward in in-depth study of data. In factor summary groups, human conditions and states and environmental factors trended downward in on-site data studies. Percentage results of on-site and in-depth trend studies were quite similar, but the two teams often differed in assigning specific causal factors in specific accidents. Representativeness of the studies was judged adequate except for driver age representation, street system mileage categories, and time coverage. Countermeasure efforts including driver education, road improvement, and periodic motor vehicle inspection are recommended.

Indiana Univ., Inst. for Res. in Public Safety, School of Public and Environmental Affairs, 400 East Seventh St.,
Bloomington, Ind. 47401
Contract DOT-HS-034-3-535
Rept. No. DOT-HS-034-3-535-74-TAC(2); 1976; 406p 6refs
Rept. for 15 Aug 1973-15 Aug 1974. Incorporates data acquired in collection Phase IV of IRPS Tri-Level Accident Investigation Program.
Availability: NTIS

HS-801 973

MULTIDISCIPLINARY ACCIDENT INVESTIGATIONS - SPECIAL STUDY OF ACTIVE AND PASSIVE RESTRAINT SYSTEMS IN 1973-1976 MODEL YEAR VEHICLES. VOL. 1. RESTRAINT SYSTEMS EFFECTIVENESS PROGRAM. FINAL REPORT

The restraint systems effectiveness phase of a multidisciplinary accident investigation program has estimated true injury-reducing effect of lapbelts and lap and shoulder belts through analysis of accident data in a Texas study area. Medical data were collected for all drivers involved in accidents from self-reported descriptions and from medical data where available. Computer programs used to process the data included TPESTR, RESCON, CDPUNCH, and SUMMARY. Results show 12.2% of unrestrained occupants, 6.2% of occupants wearing lapbelts only, and 4.8% of occupants wearing both lap and shoulder belts sustained injuries in traffic accidents. The lapbelts were 49.7% more effective in reducing injuries than no belts, lap and shoulder belts were 61.1% more effective in such cases, and lap and shoulder belts were 22.6% more effective than only lapbelts. Belt usage and effectiveness and crash injuries were shown to vary for different damage severities, crash configurations, vehicle sizes, occupant age, and seating positions. Damage was shown to be a useful measure of crash severity and correlated directly with injury severity. Mechanisms of belt-caused injury, frequency and consequences of improperly worn belts, special problems of unusual sized occupants with belts, and incidence of defeat of

restraint systems are also discussed. It is concluded that restraints when used result in fewer and less severe injuries.

by J. Robert Cromack, et al.
Southwest Res. Inst., 8500 Culebra Rd., San Antonio, Tex.
78284
Contract DOT-HS-024-1-115
Rept. No. SRI-11-3075; 1976; 64p 2refs
Rept. for 19 Mar 1974-22 Mar 1976.
Availability: NTIS

HS-801 983

SACRAMENTO, CALIFORNIA SELECTIVE TRAFFIC ENFORCEMENT PROGRAM. FINAL REPORT

Experiments were carried out to demonstrate, test, and evaluate the effect of Selective Traffic Enforcement Program (STEP) countermeasures (police, judicial, public information, and traffic engineering) applied through the entire spectrum of traffic enforcement and control on the frequency and severity of traffic accidents. Principal countermeasure activities employed were: police (radar, general patrol, and driving under the influence (DUI) enforcement); judicial (regular court procedures and conferences); public information (weekly news releases on STEP, articles on STEP for national publications); traffic engineering (studies of traffic flow and accidents, speed surveys, and maintenance and improvements as needed). The police countermeasures were the most novel and important activities of the Sacramento STEP project. Most significant results were obtained in the DUI experiment, showing exact negative correlation between fatal accidents and times of DUI enforcement in specified areas of the city. The radar and general patrol countermeasure combination proved effective in some experiments but not in others, and the fixed point enforcement countermeasures did not reduce accidents and had an adverse effect on morale of STEP officers. A mathematical model developed to test whether enforcement produced any halo effects either spatially or temporally indicated that no halo effect occurred. The STEP development of judges' conferences with police, prosecution, and judicial elements of the traffic system meeting to discuss improvement of the system and alleviation of problem areas is considered an effective part of the program. Public information countermeasures were initially useful in creating public acceptance of STEP. Traffic engineering enforcement countermeasures were not evaluated due to their preexistence. It is concluded that selective enforcement according to determined activities and content can positively affect traffic safety.

by Tom McEwen; Fran Brazil
Sacramento Police Dept., Sacramento, Calif.; PRC Public Management Services, Inc., McLean, Va.
Contract DOT-HS-109-1-155
1976; 124p 1ref
Rept. for Jun 1971-Mar 1975.
Availability: NTIS

HS-801 984

EL PASO, TEXAS SELECTIVE TRAFFIC ENFORCEMENT PROGRAM. FINAL REPORT

An evaluation of the El Paso, Texas Selective Enforcement Program (STEP) considers its effectiveness in reducing the frequency and severity of traffic accidents and increasing traffic enforcement and control. Tested activities included the following: police (patrol and cite, radar, fixed point enforcement,

and suspended/revoked licenses enforcement); judicial (regular court procedures and conferences); public information (weekly news releases on STEP, articles for national publications); and traffic engineering (studies of traffic flow and accidents, speed surveys, and maintenance and improvements as needed). Use of controlled areas as a major criteria for determining change in accident frequency and severity proved impossible in El Paso, but relative effects could be measured. Of the various accident countermeasures, those of the police proved relatively ineffective in most experiments with only small decreases in accident incidence noted in some periods which could not be positively correlated with STEP. Fixed-post, line, and area patrols were judged ineffective. Judicial procedures streamlined court activity in relation to traffic cases, and two municipal courts expanded to three. Public information policies maintained favorable publicity for STEP throughout the program. One special effort at applying STEP which proved the ability of such accident countermeasures was that made during the Dec 1973 holiday season: combined use of newspaper, television, and radio announcements and selective enforcement produced the lowest number of accidents for such a period in three years.

by Tom McEwen
El Paso Police Dept., El Paso, Tex.; PRC Public Management Services, Inc.; McLean, Va.
Contract DOT-HS-110-1-156
1976; 71p 1ref
Rept. for Jun 1971-Mar 1975.
Availability: NTIS

HS-801 989

DESIGN OF NASS: SUPPLEMENTAL INFORMATION FOR PLANNING THE NATIONAL ACCIDENT SAMPLING SYSTEM. FINAL REPORT

Supplemental information for planning and design of a National Accident Sampling System (NASS) for the Office of Statistics and Analysis (OSA) of the National Highway Traffic Safety Administration is presented. Revisions to the NASS design were made regarding formation and selection of primary sampling units (PSU) and the sample allocation. Two new sets of potential PSUs from which final accident investigation sites could be chosen in NASS implementation were developed, using more than 50,000 people as minimum size criteria. Different stratification criteria in density and climate were used to develop these PSUs, and probabilities of selection for each stratum within each plan were determined for the seven selected PSUs. This revision provides flexibility in NASS implementation with regard to PSU size. Different allocations of workload within each PSU were delineated to explore interaction between accident production of various PSUs and within-PSU sampling fractions assigned to achieve desired case mix, considering costs of various data collection team compositions (cost function) and case load production (crashworthiness) expected. Cost estimates were combined as a basis for analysis, considered in conjunction with case output for different team sizes with rates of homogeneity and standard errors of estimate on key accident variables. The tradeoffs among operating costs for particular PSUs, case output of each team, and accuracy of estimates on key variables can be evaluated as a means of optimizing PSU number. This revision to the NASS plan considers the effect of structures on accuracy of estimation of national rates and trends forming the major product of continuous sampling subsystems of NASS. These revisions incorporated with the original design

December 31, 1977

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provide OSA with a significantly broader base in deliberations for implementing specific NASS designs. Appendices list PSUs by stratum with cumulative populations and county/town components of potential PSUs, and give 14 sets of output from the Groves-Hess controlled selection computer program showing weighted possible patterns of PSU selection among plan strata.

by R. Kaplan; A. Wolfe
University of Michigan, Hwy. Safety Res. Inst., Ann Arbor,
Mich. 48109
Contract DOT-HS-6-5368; DOT-HS-6-5369
Rept. No. UM-HSRI-76-15; 1976; 118p 4refs
Rept. for Dec 1975-Apr 1976. Supplements UM-HSRI-SA-75-14.
Availability: NTIS

HS-802 004

DEVELOPMENT OF A UNITIZED SCHOOL BUS. VOL. 1 - SUMMARY REPORT

New design concepts for school bus body structures and for passive restraint system configurations were studied to provide passenger protection in front, rear, and side impacts at 30 mph velocity. A unitized bus configuration was specified wherein the body and chassis frame are a single integrated structure rather than bolted together as previously typical. Injury criteria and mechanisms of protection were considered for three occupant sizes: 50th percentile of 6 year old child, 5th percentile adult female, and 50th percentile adult male. The passive restraint system was designed to absorb the energy of contacting occupants through padding and deformation capability and to control phasing of occupant body motions during contact. Development sled tests were carried out to measure impact effects on bus damage and injury to occupants. The designed unitized bus with passive restraint system adequately protected seated occupants (dummies) in front and rear impacts but not in side impact. Layouts of a 55-passenger operational school bus incorporating the design improvements were prepared. Production costs for the improved bus are estimated at \$2,500 more than a typical 66-passenger school bus. Producibility and maintainability of the bus were concluded to be equivalent to conventional designs.

by L. Adams; A. Khadilkar; L. Pauls; W. Rup
AMF Advanced Systems Lab., 495 South Fairview Ave.,
Goleta, Calif. 93017
Contract DOT-HS-4-00969
1976; 31p
Rept. for Jun 1974-Apr 1976. Other volumes in the report series are Vol. 2 - Technical Report and Vol. 3 - Appendices.
Availability: NTIS

HS-802 008

ADVANCED HEADLIGHTING SYSTEMS. FINAL REPORT

An evaluation of possible glare reduction measures was carried out comparing advantages and disadvantages of tinted windscreens, glare-absorbing paint, sharply curved surfaces, headlamp dimming schemes, road design, linear polarizers, circular and elliptical polarizers, strobe (time-sharing) systems, monochromatic headlamps, alternative polarizers, birefringent material, Varad, and emission polarizing light bulbs. Complications, inefficiency, and high cost factors identified with most of the alternatives considered indicate the comparative ad-

vantages of linear and circular polarization headlighting systems. Laboratory and road test measurements of these systems resulted in selection of a headlighting system consisting of linear polarizer and analyzer for official adoption as the standard headlighting system. Transmittances, light extinction parameters, seeing distances, rearview mirror glare extinction, taillight visibility, and available beam patterns were studied and found satisfactory in relation to the recommended system. Changeover procedures in accomplishing total conversion to linearly polarized headlighting systems are recommended for the period 1981 to 1985.

by Raymond E. Zirkle; Marjorie J. Krebs; Robert Curran
Honeywell, Inc., Systems and Res. Dept., 2600 Ridgway
Parkway, Minneapolis, Minn. 55413
Contract DOT-HS-4-01006
Rept. No. 76SRC12; 1976; 70p 47refs
Rept. for Jun 1974-Dec 1975.
Availability: NTIS

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**University of Maryland, Mechanical Engineering Dept.,
College Park, Md.**

TEST PROCEDURES FOR THE EVALUATION OF
AERODYNAMIC DRAG ON FULL-SCALE VEHICLES
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HS-019 062

**University of Michigan, Hwy. Safety Res. Inst., Ann
Arbor, Mich. 48109**

A PREDICTION OF RESPONSE OF THE HEAD AND
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HS-019 047

**University of Michigan, Hwy. Safety Res. Inst., Ann
Arbor, Mich. 48104**

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HS-019 125

**University of Michigan, Hwy. Safety Res. Inst., Ann
Arbor, Mich. 48109**

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HS-801 989

**University of North Carolina, School of Medicine,
Chapel Hill, N.C. 27514**

ASSESSMENT OF TOXICITY OF AUTOMOTIVE
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**University of Southern California, Inst. of Safety and
Systems Management**

AN HISTORICAL OVERVIEW OF RESEARCH IN
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**University of Texas Medical School at San Antonio, Div.
of Orthopaedics, San Antonio, Tex.**

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University of Texas, Arlington, Tex.

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University of Toledo, Toledo, Ohio

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HS-018 974

**Urban Mass Transportation Administration, Washington,
D.C. 20590**

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Urban Planning Div., Federal Hwy. Administration

A HIGHWAY SAFETY STANDARD FOR BICYCLE
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**Virginia Hwy. and Transportation Res. Council,
Charlottesville, Va.**

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HS-019 030

Volkswagenwerk AG, West Germany

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HS-019 079

**Volkswagenwerk, A.G., Res. Div., Federal Republic of
West Germany**

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HS-018 976

**West Virginia State Office of Comprehensive Health
Planning, Charleston, W. Va.**

GOVERNOR'S HIGHWAY SAFETY ADMINISTRATION
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HS-019 084

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Energy Res. and Devel. Administration, Bartlesville Energy
Res. Center, P.O. Box 1398, Bartlesville, Okla. 74003

HS-019 111

68-02-1205

University of North Carolina, School of Medicine, Chapel
Hill, N.C. 27514

HS-019 064

68-02-1701

University of North Carolina, School of Medicine, Chapel
Hill, N.C. 27514

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CONTRACTS AWARDED

DOT-HS-6-01342

MARK II VISION TESTER

The contractor shall furnish all the necessary qualified personnel, facilities, materials and services; and in consultation with the Government, manufacture Mark II Integrated Driver Vision Testing Services. The objective of this project is to manufacture multiple replicas of Mark II Integrated Vision Testers for use in measuring and testing visual functions important to safe driving performance. The effort shall be divided into 3 phases--Phase I being the design modification and production plan for the Mark II Vision Testers, Phase II--the production and testing of five operational vision testers, and Phase III--the fabrication, reliability testing, quality assurance and delivery of the second five testers.

Honeywell, Inc., 2600 Ridgway Parkway, Minneapolis,
Minnesota 55413
\$450,297.00

To be completed within eighteen (18) months after the date of award.

DOT-HS-6-01343

FIFTH WHEEL LOCATION INFLUENCE ON VEHICLE MOTION

In order for the National Highway Traffic Safety Administration (NHTSA) to take possible rulemaking action concerning the fifth wheel location on tractor trailers, information gaps must be filled. This objective will be accomplished by two distinct tasks, namely, determining the lateral motion aspect and the vertical motion aspect. The effect of the fifth wheel location on the lateral motion will be obtained through test type simulation data that will indicate the influence on steering effort, controllability, as well as on magnitude of change of handling characteristics. The vertical motion influence will be determined by reviewing existing models and selecting the appropriate model for determination of vehicle vibration characteristics on road surfaces. The selected model will be tested to determine how vehicle fifth wheel geometry influences the vibration. This vibration will be related to various safety factors. Finally a tabulation of allowed locations will be determined to provide the driver with information to account for maneuver possibilities and roadway surfaces.

Massachusetts Institute of Technology, Department of
Mechanical Engineering, Cambridge, Massachusetts 02139
\$24,093.00

To be completed within one (1) year after date of award.

DOT-HS-6-01345

ENFORCEMENT OF THE NATIONAL SPEED LIMIT

The objective of this project is to develop a profile of existing practices used by State Police/Highway Patrols in enforcing the National Maximum Speed Limit (NMSL), identify the cost benefits of selected practices, and prepare a "How To Do" manual for police administrators. This project consists of three phases. Phase I will identify all current practices utilized by all state police/highway patrol agencies in enforcing the NMSL

and a report containing a summary, analysis and commentary will be prepared. Phase II will consist of the selection of specific speed enforcement practices for a detailed evaluation. The selected practices and techniques will be in operation in a real world environment and an analysis and evaluation will be submitted in report form. Phase III will consist of the preparation of a comprehensive enforcement manual which will describe the variety of contemporary enforcement practices and techniques, their cost-effectiveness and cost-benefit and methodologies for determining same. 0for

International Association of Chiefs of Police, Inc., Eleven
Firstfield Road, Gaithersburg, Maryland 20760
\$259,066.00

To be completed within three (3) years after the date of award.

DOT-HS-6-01354

FARS COMPUTER REWRITE SYSTEM

This project involves the maintenance and modification of the existing FARS system as a result of inputs from users of the system. Detailed changes shall be made to the system in order to meet the immediate needs of all users. This contract will handle all required maintenance and on-demand modifications to the existing FARS system until the new re-written FARS system becomes operational in May 1976. Also all of the changes made to the existing system which reflect new user requirements shall be documented by the contractor for incorporation into the new re-written FARS computer system.

Control Data Corporation, 6003 Executive Boulevard,
Rockville, Maryland 20852
\$28,505.00

To be completed by 30 Jul 1976.

DOT-HS-6-01357

HYDRAULIC BRAKE SYSTEMS

The contractor is to perform inspection and testing services in accordance with FMVSS No. 105-75 as outlined in National Highway Traffic Safety Administration (NHTSA), Office of Standards Enforcement (OSE) Laboratory Test Procedure TP-105-75-00 dated December 19, 1975, in sections 1 through 12.

Ultrasystems, Inc., Dynamic Science Division, 1850 W.
Pinnacle Peak Road, Phoenix, Arizona 85027

To be completed within one (1) year after the date of award.

DOT-HS-6-01358

HYDRAULIC BRAKE SYSTEMS

The contractor is to perform inspection and testing services in accordance with FMVSS No. 105-75-00 as in National Highway Traffic Safety Administration (NHTSA), Office of

Standards Enforcement (OSE) Laboratory Test Procedure TP-105-75-00 dated December 19, 1975, in sections 1 through 12.

North American Testing Company, 1801 Speedway Boulevard, P.O. Drawer S, Daytona Beach, Florida 32015

To be completed within one (1) year after date of award.

DOT-HS-6-01359

VEHICLE ROLLOVER TEST PROCEDURE - COMPUTER EVALUATION

The objective of this study is to find, by means of computer simulation a test device that causes the least variation in angular lift-off velocity when the suspension and other appropriate parameters are varied over a reasonable range. To accomplish this, the contractor shall perform three tasks. Task I involves developing a plan demonstrating how the Highway Vehicle Object Simulation Model (HVOSM) can be utilized to predict an optimum rollover test device. Task II will use the data obtained in Task I. The parameter variations determined will be used as input for each type of vehicle with each device and the results will be presented in tabular form. Task III will be to estimate the feasibility and cost of constructing the test device. n a

Calspan Corporation, P.O. Box 235, Buffalo, New York 14221
\$16,874.00

To be completed within three (3) months after date of award.

DOT-HS-6-01362

MOTOR VEHICLE INSPECTION TRAINING STATE AND COMMUNITY INSTRUCTORS

The project will present training materials developed under a previous contract to a group of potential users in a workshop for educators and training officials in vehicle inspection programs. It will provide a 30-hour training course to selected instructors who will become familiar with the competent in conducting the National Highway Traffic Safety Administration course entitled "Motor Vehicle Inspection Training". The instructor training course will be based upon and adapted from the U.S. Office of Education's Preparation of Occupational Instructors: A Suggested Course Guide and should qualify for college credit. Sections of 15 students will attend the instructor-training course at one of 5 sites; in all 75 students will be selected to participate. This selection is to be done on the basis of competency in the area of motor vehicle inspection. 0he

Dunlap and Associates, Inc., One Parkland Drive, Darien, Fairfield, Connecticut 06820
\$50,289.00

To be completed within twelve (12) months after the date of award.

DOT-HS-6-01365

MULTIVARIATE MODELING AND ANALYSIS

The National Highway Traffic Safety Administration (NHTSA) is engaged in research activities which are monitoring the responses and variation of responses of system as conditions of the tests or systems are varied. The object of this project is the generation and formulation of mathematical expressions which will have the ability to predict the outcome of an event given adequate and appropriate parameters which define the system or test prior to or during the event. The contractor shall utilize the adaptive modeling and system control techniques embodied in the proprietary computer software program (SMOOTH, PARAM, PARAFF, CLUSTR, PNETTR, PARSNS, GARS, NBAYES) of Adaptronics, Inc., to analyze NHTSA provided data.

ADAPTRONICS, Inc., Westgate Research Park, 7700 Old Springhouse Road, McLean, Virginia 22101

The contract shall remain in effect for a period of twelve (12) months from the date of award.

DOT-HS-6-01367

DEVELOPMENT OF CALIBRATION AND TEST PROCEDURES FOR THREE-YEAR-OLD COMPLIANCE TEST DUMMY

There are many factors in child seat testing which can influence performance of a child restraint system. Those factors related to the dummy are the physical characteristics of the components of the test dummy, the interaction of the dummy components as a total system, and the installation and test set-up procedures used in placing the dummy in the restraint system. Since variations in any of these factors can lead to variability in test results, the factors must be quantified and limits set on allowable ranges of variation in terms of their effect on performance criteria. This project addresses this problem in the form of 3 separate research tasks, each aimed specifically at one of the above factors as it relates to the 3-year-old child test dummy. Based on this work the Contractor shall develop suitable recommendations and rationale for the child dummy rulemaking, including detailed test methodology and test procedures, performance, and calibration criterias, and acceptability norms where appropriate. 0 to

The Regents of the University of Michigan, 260 Research Administration Building, Ann Arbor, Michigan 48105
\$27,575.00

To be completed 10 Nov 1976.

DOT-HS-6-01370

DEVELOPMENT AND APPLICATION OF ANALYTICAL AND STATISTICAL METHODS IN VEHICLE STRUCTURES RESEARCH

The purpose of this project is to delineate engineering, mathematical analysis and computer programming services that are required in support of Highway Traffic Safety Research in the study of vehicle structures. The development and application of analytical and statistical methods in structures research requires extensive software generation, data collection, and

data handling. Specifically these requirements include: Static Crush Data for Vehicle Front and Side Structures; Dynamic Crash Test Data for Vehicle Front and Side Structures; Data Coding and Collation; Optimization Models; and Vehicle and Occupant Simulation Programs. 01e

"This contract is awarded by the Small Business Administration under the authority of Section 8(a) of the Small Business Act (USC 637a), and will be administered by the Department of Transportation, National Highway Traffic Safety Administration."

\$130,088.00

To be completed one (1) year after contract award date.

DOT-HS-6-01374

MODEL FOR PROVISIONAL (GRADUATED) LICENSING

The contract is for developing a model for a novice driver provisional (graduated) licensing program. The program will prepare the novice driver for a full driving privilege in progressively more responsible stages. The model may include activities prior to formal training and licensing, activities during the learning or permit stage, and post licensing control measures. The applicability and impact of the various efforts applied in the U.S. and abroad to bring the novice driver to full driving privilege will be determined. A number of alternatives may be presented to NHTSA. After review and determination of the appropriate program the contractor will establish legislative, administrative, operational and training requirements for the model program and include a review by the appropriate State and traffic research officials and community support organizations such as PTAs. 0 an

Teknekron, Inc., 4701 Sangamore Road, Washington, D.C. 20016

\$36,753.00

To be completed within six (6) months after data of award.

DOT-HS-6-01376

REVISION OF NHTSA CURRICULUM PACKAGES

A general review shall be conducted of National Highway Traffic Safety Administration (NHTSA) curriculum packages currently in print by the U.S. Government Printing Office. All published curriculum materials will be reviewed and analyzed and the need for revision will be determined, in consultation with NHTSA and other authoritative personnel. Up to 3 curriculum packages will be selected for revision as needed. The contractor, employing a standardized format, shall determine and report required revisions and rewrite, delete, or add content as dictated by the analysis. Extensive redevelopment or origination of substantive content is not intended.

Applied Science Associates, Inc., Box 158, Valencia, Butler County, Pennsylvania

\$49,911.00

To be completed within twelve (12) months after the date of award.

DOT-HS-6-01378

MOTOR VEHICLE MATERIALS HISTORICAL HIGH-VOLUME INDUSTRIAL PROCESSING RATES DATA BANK

This contract will provide data on the third (a 1976 Audi) and fourth (a 1976 VW Rabbit) of four passenger vehicles needed to complete the study for identification and establishment of a motor vehicle materials high-volume industrial processing cost passenger car data bank. One of these models (2500-3000 lbs) was chosen because it is believed that it represents the same roominess and safety levels as American intermediate cars (3600-4000 lbs) and to be more representative of 1980 and beyond in U.S. intermediate cars. The contract will provide information as to how more safety can be obtained at a lower weight. This data is needed to establish the reference base data bank for implementing a simplified building-block estimating system that will facilitate the estimating task, establish standardized across-the-board estimating procedures and generate consumer cost estimates for proposed rulemaking actions. For each vehicle the contract will identify the subassemblies and subassembly components by weight, material, processing methods, the fixed and variable cost-per-pound, production volume economics, cycle-run and markup elements that make up the consumer price of the vehicles as if the vehicles were manufactured in the U.S. 0t \$

Pioneering Engineering and Manufacturing Co., 2500 E. Nine Mile, Warren, Michigan 48091

\$199,047.00

To be completed within nine (9) months after date of award.

DOT-HS-6-01380

EVALUATION OF FMVSS NO. 103 IDLE TEST VS. ROAD LOAD TEST

The objective of this project is to obtain comparative data by testing sever vehicles using the two different compliance procedures specified in FMVSS No. 10 "Windshield Defrosting and Defogging System." The data obtained will be used to evaluate the two alternative compliance methods for possible modification of FMVSS No. 103 in future rulemaking. All test vehicles shall be 1976 model passe cars. The defrosting pattern on the windshield will be outlined using both comp procedures, the windshield contours will be photographed and traced on a windshi overlay.

Ball Brothers Research Corporation, Aerospace Division, P.O.

Box 1062, Boulder, Boulder County, Colorado 80302

\$35,413.00

To be completed within six (6) months from date of award.

DOT-HS-6-01383

OPTIMIZED BRAKE INSPECTION

The objectives of this research project are to perform a review and synthesis of past vehicle-in-use brake research and to develop an optimum brake inspection program in terms of brake performance and/or component condition, effectiveness and frequency of the inspection, and equipment, keeping in mind the two types of State programs for motor vehicle inspection (State-owned or State-appointed facilities). Twenty vehicles selected at random shall be inspected, using the op-

timum brake inspection program, to prove that the program is viable. Odur

Ultrasystems, Inc., 2400 Michelson Drive, Irvine, California 92715
\$175,707.00
To be completed within twelve (12) months after date of award.

DOT-HS-6-01387

TRUCK, BUS, AND MOTORCYCLE SAFETY STATUS METHODOLOGY

The objectives of this research project are twofold. First, the contractor is to determine the feasibility of surveying the safety status of the truck, bus, and motorcycle-in-use populations. Bureau of Motor Carrier Safety (BMCS) data shall be evaluated relative to applicability and utility as well as the need to survey vehicles subject to the BMCS jurisdiction. Secondly, the contractor is to develop and validate a methodology for surveying the condition of trucks, buses and motorcycles cost-effectively. To accomplish this end the contractor shall design a field experiment to support the cost-effective and efficient survey of the desired vehicle population including sampling technique, sampling matrix, sample size, and sample site criteria. 0 es

Indiana University Foundation, 355 North Lancing Street, Indianapolis, Indiana 46402
\$138,778.00
To be completed within fourteen (14) months after date of award.

DOT-HS-6-01398

IMPROVED VISIBILITY FOR SCHOOL BUSES DURING ADVERSE WEATHER

Bus driver visibility is a frequent problem during inclement weather. The respiration of passengers coupled with wet clothing and periodic opening and closing of the entrance door in cool rainy weather creates a very humid environment which can promote fog formation on the inside of the bus, glazing surfaces which in turn limits driver visibility directly through the windshield and indirectly through the mirror systems. It is this problem of visibility that is the focus of this project. The contractor shall perform a limited state-of-the-art survey. The contractor shall develop a "family" of performance requirements for bus visibility systems covering Type I, Type II and contract transit school buses. Using these performance requirements the contractor shall prepare detailed developmental test procedures applicable to the selected buses. As a result of data analysis a compliance test procedure will be developed.

Ultrasystems, Inc., Dynamic Science Division, 1850 W. Pinnacle Peak Road, Phoenix, Arizona 85027
\$89,538.00
To be completed within twelve (12) months after date of award.

DOT-HS-6-01417

AN EVALUATION OF THE ADEQUACY AND APPROPRIATENESS OF THE NHTSA UNIFORM HIGHWAY SAFETY STANDARDS

The objective of this procurement is to develop an approach, collect and analyze the necessary information and prepare a summary report enabling the Department of Transportation (DOT) to prepare the required report to Congress on the adequacy and appropriateness of the Standards. n t

Safety Management Institute, 7979 Old Georgetown Road, Suite 500, Bethesda, Maryland 20014
\$95,393.86

To be completed within eleven (11) months after the date of award.

DOT-HS-6-01400

RESPONSE OF DUMMIES AND CADAVERS TO SIDE AND REAR IMPACT

The objective of this program is to compare the kinematics in side impacts to seated cadavers and anthropomorphic dummies and to determine what injuries occur to the cadavers. Although injuries that may occur to the cadavers are important, primary concern shall be the reproducibility of the crash environment from one test to the next and the acquisition of data so valid comparison of dummy and cadaver kinematics can be made. 0yst

Regents of New Mexico State University, Physical Science Laboratory, P.O. Box 3548, Las Cruces, New Mexico 88003
\$277,505.00

To be completed 30 Jun 1977.

DOT-HS-6-01418

COMPUTER EVALUATION SUPPORT

The contractor will provide continuing support for the Alcohol Safety, Action Program (ASAP) Evaluation Data System (EDS), maintaining and operating the system remotely or at the National Institutes of Health (NIH) Computer Facility. This includes not only operation of all subsystems of the EDS but modifying any of the subsystems to satisfy changing reporting requirements. Abstracting, systems analysis and programming support for the Project Status Display System, and data collecting, editing and programming support for the ASAP monthly system is to be furnished. The contractor is to give support to the expansion of existing subsystems and provide computer support by developing new programs or reviewing existing ones at the NIH Computer Facility. 0nsi

Teknekron, Inc., 4701 Sangamore Road, Washington, D.C. 20016
\$82,522.00

To be completed within twelve (12) months after date of award.

December 31, 1977

DOT-HS-6-01386

**PERFORMANCE LEVELS OF FACTORS FOR
PERFORMANCE OF POLICE TRAFFIC SERVICES**

The performance levels of factors for performance of police traffic services that have been identified and defined in a previous contract (Contract DOT-HS-5-01272) are to be analyzed and gradations of performance for each of the factors are to be identified and defined. The establishment of gradations must take into consideration levels of nonacceptability and acceptability as well as the conditions under which the tasks are performed such as functional, geographic and time assignments, and highway and traffic characteristics. The performance of the task of preparing report such as citations, accident investigation reports, and daily activity reports, will be measured in part by an error rate. The error rate can be defined as the number of omissions, or incorrectly marked boxes or inaccurate information divided by the number of reports submitted. Additional job factors will be defined and evaluated so that objective assessments can be made on employee performance. Those factors used, the methodology employed, and the variables which influence performance will be described. The purpose is to improve the quality and increase the quantity of police traffic services. up

Dunlap & Associates, One Parkland Drive, Darien,
Connecticut 06820
\$72,352.00
To be completed twelve (12) months from date of contract
award

DOT-HS-6-01395

**SAFETY HELMET PERFORMANCE
INVESTIGATION**

The feasibility of performing compliance tests with various sizes of test headforms to evaluate safety helmet performance will be investigated. A coordination of data plots for Cragar prototype sizes A, B, and D headforms will be made using data from the final report of Contract DOT-HS-4-00802 (Safety Helmet Performance Investigation, Vol. 2). A correlation of the Cragar prototype size C headform with the ANSI-Z90.1 headform will be made. The performance of verification testing with Cragar prototype headforms A, B, and D will be studied and the results analyzed to determine adequacy of the Cragar Prototype headforms for FMVSS 218 compliance testing. Calculations to prepare Department of Transportation-National Highway Traffic Safety Administration (DOT-NHTSA) headform data and information for inclusion in FMVSS No. 218 (Docket 72-6) will be made. 0e i

Southwest Research Institute, 8500 Culebra Rd., San Antonio,
Texas 78284
\$35,680.00
To be completed by 30 Dec 76

DOT-HS-6-01399

LABORATORY TESTING PROCEDURES

The development and demonstration of laboratory procedures for testing of school buses according to four Federal Motor Vehicle Safety Standards (FMVSS) will be undertaken. The safety standards are FMVSS No. 220, "School Bus Roll Over

DOT-HS-6-01419

Protection," FMVSS No. 221, "School Bus Body Joint Strength," FMVSS No. 222, "School Bus Seating & Crush Protection," and FMVSS No. 301-75, "Fuel System Integrity".

Southwest Research Institute, 8500 Culebra Rd., San Antonio,
Texas 78284
\$37,705.00
To be completed by 15 Oct 76

DOT-HS-6-01401

**TRAFFIC SAFETY DEMONSTRATION PROGRAM
MODELING SYSTEM**

Some modifications in the National Highway Traffic Safety Administration's traffic safety demonstration model (DEMON) in order to upgrade and improve the demonstration evaluation modeling system shall be made. The modeling system will be modified to allow project parameters to vary within the operational period (capability to model a variable input flow rate, Office of Driver and Pedestrian Programs capability to model a variable workload capability, and capability for model feedback). The modeling system's data files and modules will be modified to encompass additional demonstration activities. User-oriented modifications would enhance the capability of the simulation and allow the user greater flexibility in analyzing the impact of the countermeasure operations on the demonstration projects.

Stanford Research Institute, 333 Ravenswood Ave., Menlo
Park, California 94025
\$49,967.00
To be completed six (6) months of contract award

DOT-HS-6-01402

NHTSA FACT BOOK MAINTENANCE

The NHTSA (National Highway Traffic Safety Administration) FACT BOOK which contains information on motor vehicle and highway safety is to be updated with statistical data and information and expanded to include additional items of interest to the highway safety community. It will be necessary to become familiar with and obtain access to sources of highway safety information, extract data pertinent to motor vehicle and traffic safety and present the data in a format appropriate to the purposes of the FACT BOOK. It is expected that the FACT BOOK will be updated quarterly and a new issue published annually. 0ion

"This contract is awarded by the Small Business Administration under the authority of Section 8(a) of the Small Business Act (USC 637a), and will be administered by the Department of Transportation, National Highway Traffic Safety Administration."
\$49,121.00
To be completed within twelve (12) months of contract award

DOT-HS-6-01419

**INSTRUCTOR TRAINING FOR NEWLY REVISED
CURRICULUM PACKAGES**

The development, organization and carrying out of refresher instructor training courses in the field of traffic safety which

will improve teaching methods and techniques while familiarizing the instructors with new and different content material will be undertaken. The project will entail conducting a 3-day instructor institute for 15 instructors for each of four curriculum packages (driver improvement analyst, emergency medical technician--ambulance, traffic court judge, and traffic records analyst). With NHTSA (National Highway Traffic Safety Administration) regional and state assistance, candidates will be recruited primarily from among instructors who have completed the pertinent previous NHTSA instructor institute. Emphasis will be on the development and presentation of a 3-day course for teaching teachers. The teaching of a selected number of State or local instructors will be incidental to the broader purpose of introducing the revised curriculum package into the mainstream of teaching activity. Ohod

Dunlap and Associates, Inc., One Parkland Drive, Darien, Connecticut 06820
\$69,540.00

To be completed within nine (9) months of contract award

DOT-HS-6-01420

ANTICIPATION OF FUTURE MOTOR VEHICLE SAFETY PROBLEMS

The establishment of an organized on-going process for anticipating, by five to fifteen years, future changes (excluding changes to the safety problem or forecast indicators associated with future effects of motor vehicle safety standards or future motor vehicle design) to the safety problem in sufficient detail to justify effective corresponding safety rulemaking actions will be accomplished. Specific objectives are to provide a report containing a practicable technique (using primarily in-house National Highway Traffic Safety Administration (NHTSA) resources) for forecasting the changes described above which could be effectively treated by issuing, adjusting or revoking specific MVSS's (Motor Vehicle Safety Standards); to apply the technique to current data and safety conditions in the United States; to develop channels for NHTSA to obtain the necessary forecast indicator data at regular intervals after completion of the Contract; and to identify any other forecast indicators which are necessary or highly desirable but which are not now available, and plans for subsequently deriving or otherwise obtaining them.

Minicars, Inc., 35 La Patera Lane, Goleta, California 93017
\$99,732.00

To be completed within twelve (12) months of contract award

DOT-HS-6-01423

IMPACT OF MOTORCYCLE HELMET USAGE IN SOUTH DAKOTA

South Dakota's law (effective date 1 Jul 77) which states that adult (over 18 years old) motorcyclists are not required to wear protective helmets while operating or riding motorcycles on public roads will be assessed to determine its effect on postcrash consequences of motorcycle accidents and on the frequency of use of protective helmets prior and after the effective dates of the legislation. The project will collect bi-level police motorcycle accident data, determine the nature and severity of the injuries sustained in these accidents by the motorcycle riders, and determine motorcycle helmet usage rates

through observational surveys. Supplementary policy accident data will be collected and shall include general information such as place and time of accident, motorcycle data such as type of cycle, and rider information such as injury to body area and usage of safety helmet. Injury severity data from medical records shall record injuries by various body areas, and the Abbreviated Injury Scale (AIS) of individual injury and the overall AIS classification shall be determined. A roadside sample survey to determine motorcycle helmet usage will be devised and implemented. An automated data system (magnetic tape) will be implemented containing specified segments of all police bi-level data and helmet usage survey data. Pr

University of South Dakota, City of Vermillion, Clay County, South Dakota 57069
\$59,889.00

To be completed within eighteen (18) months of contract award

DOT-HS-6-01426

DRIVER VISIBILITY REQUIREMENTS--QUALITY OF VISIBILITY

The basis for the generation of realistic standards for the most fundamental aspect of driver visibility quality which is the degree of clarity or sharpness of an image (hereafter referred to as optical quality) will be developed. Accomplishment of this objective requires development and validation of a quantitative method for objectively measuring the optical quality of vehicular glazing surfaces as a function of the environmental/meteorological effects (e.g. collection of foreign material such as dust or frost on exterior glazing surface, condensation on interior surface, ornamentation in or on glazing material, distortions in the glazing material itself, etc.), and determination of the relationship between optical quality and driving-related visual performance of drivers.

Human Factors Research, 6780 Cortona Drive, Goleta, California 93017
\$94,643.00

To be completed within ten (10) months of contract award

DOT-HS-6-01427

EVALUATION OF ROLLOVER PROCEDURES

An evaluation of a rollover procedure with a vehicle oriented 45° to the line of travel instead of the normal 90° will be accomplished. Three vehicles will be rolled on a vehicle carrier (as specified in FMVSS No. 208) to establish repeatability at their facility. The vehicle carrier will then be modified to hold a vehicle at 45° to the line of travel. Five rollover tests will be performed on the modified carrier to evaluate the new rollover procedure. of

Ultrasystems, Inc., Dynamic Science Division, 1850 West Pinnacle Peak Rd., Phoenix, Arizona 85027
\$71,357.00

To be completed within twelve (12) months of contract award

December 31, 1977

DOT-HS-6-01428

POWER STEERING FAILURE STUDY

A power steering failure study will be undertaken to determine the feasibility of modifying power steering systems to prevent excessive steering effort resulting from power steering failure, to investigate the severity of excessive free play in power steering systems resulting from power steering failure, and to investigate the severity of the problem of overrunning power steering systems. Vehicles from three manufacturers will be used, each equipped with test tires similar to original equipment manufacturers specifications. The steering effort mitigation study will include an analysis of a technique that will allow the power steering hydraulic fluid to bypass the power steering pump when an engine stalls, a belt breaks or a pump fails. Steering wheel torque transducers will be utilized to measure steering effort. Steering wheel position transducers will be used to plot steering wheel position as a function of time.

Systems Technology, Inc., 13766 South Hawthorne Blvd.,
Hawthorne, California 90250
\$47,356.00

To be completed by June 30, 1977

DOT-HS-6-01429

IMPACT OF MOTORCYCLE HELMET USAGE IN COLORADO

Motorcycle helmet usage in Colorado will be analyzed to collect motorcycle accident data and supplementary accident information from police and medical authorities, and to determine frequency and severity of injury to specific body areas sustained in accidents by motorcycle riders. Motorcycle helmet usage rates will be determined through observational surveys on selected roadways representative of the State of Colorado such that valid statistical inferential statements can be made, and data files will be automated to permit analysis of helmet usage and injury data collection. 0e p

State of Colorado, Department of Highways, Division of
Highway Safety, 4201 East Arkansas Ave., Denver, Colorado
80222
\$70,000.00

To be completed within eighteen (18) months of contract award

DOT-HS-6-01430

VEHICLE SEAT BACK LATCH INVESTIGATION

An investigation of existing seat back latch mechanisms will be undertaken to provide a data base for upgrading the requirements on such devices in Federal Motor Vehicle Safety Standard No. 207, Seating Systems. Performance data as well as human factors evaluations on locations and design of release controls is required to support rulemaking action. Data will be provided on how seat back latch release forces increase with static loads on the rear of seat backs in a wide variety of domestic and foreign cars with various latch designs. Evaluation will be made of the inertial seat back latch mechanism on a selected vehicle model during lock up conditions while braking severely in primary and secondary latch positions; and a human factors evaluation of seat back latch release mechanisms will be provided. A static seat latch test

will be made on each of 12 vehicles. A dynamic latch test will be made with the latch in primary and secondary positions. A human factors evaluation will be made using a test panel of 12 persons who are not automotive oriented and using the techniques and format used on Contract DOT-HS-230-3-674 conducted by Man Factors, Inc. (San Diego, California), to evaluate "Sources and Remedies for Restraint System Discomfort and Inconveniences." of

Ultrasystems, Inc., Dynamic Science Div., 1850 West Pinnacle
Peak Rd., Phoenix, Arizona 85027
\$28,552.00

To be completed within ninety (90) days of contract award

DOT-HS-6-01433

PARTS RETURN PROGRAM

The operations of the National Highway Traffic Safety Administration (NHTSA) Parts Return Program (PRP), whose primary purpose is to gather information on defective automotive components from independent repair shops on a voluntary basis, will be continued. Under the authority of the National Traffic and Motor Vehicle Safety Act of 1966, as amended, the NHTSA can require manufacturers to conduct safety defect notification campaigns when it has been determined that a defect relating to motor vehicle safety exists. In addition to collecting information on defective components, the program shall maintain its current number of enlisted repair shops enrolled in the PRP, and increase the current number of participating shops from those enlisted in the PRP.

Kappa Systems, Inc., 1501 Wilson Blvd., Arlington, Virginia
22209
\$65,089.00

To be completed within twelve (12) months of contract award

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY
ADMINISTRATION

Washington, D.C. 20590

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